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FINAL REVISON 1, RADIOLOGICAL CHARACTERIZATION SURVEYS WORK PLAN, PARCEL F STRUCTURES

11/19/2018

APTIM FEDERAL SERVICES, LLC

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Naval Facilities Engineering Command Southwest
BRAC PMO West
San Diego, CA

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RADIOLOGICAL CHARACTERIZATION SURVEYS WORK PLAN

Parcel F Structures

HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

November 2018

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Prepared for:

Department of the Navy
Naval Facilities Engineering Command Southwest
BRAC PMO West
33000 Nixie Way, Bldg. 50
San Diego, CA 92147

Prepared by:

Aptim Federal Services, LLC
4005 Port Chicago Highway, Suite 200
Concord, CA 94520

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November 2018

James M. Langsted, CHP Project Health Physicist	November 19, 2018 Date
Raymond Schul Radiological Operations Manager	November 19, 2018 Date
Lisa Bercik, PE Project Manager	November 19, 2018 Date

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Acronyms and Abbreviations

α	sigma (variability)
^{90}Sr	strontium-90
^{137}Cs	cesium-137
^{226}Ra	radium-226
^{239}Pu	plutonium-239
ALARA	as low as reasonably achievable
AM	*Final Basewide Radiological Removal Action, Action Memorandum—Revision 2006, Hunters Point Shipyard, San Francisco, California*
AMS	APTIM Management System
APP/SSHP	*Accident Prevention Plan, Radiological Work Tasks, Remedial Action and Maintenance of Remedies at Hunters Point Naval Shipyard, San Francisco, California*
APTIM	Aptim Federal Services, LLC
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
cm	centimeter
cm/sec	centimeter per second
cm^2	square centimeter
CQCP	contractor quality control plan
CSO	Caretaker Site Office
CTO	contract task order
dpm	disintegration per minute
DQO	data quality objective
DTSC	California Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
GPS	global positioning system
HPNS	Hunters Point Naval Shipyard
HRA	*Final Historical Radiological Assessment Volume II, History and the Use of General Radioactive Materials, 1939-2003*
IL	investigation level
LLRW	low-level radioactive waste
m/s	meter per second
MARSSIM	*Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*
MDA	minimum detectable activity
MDC	minimum detectable concentration
N	number
NaI	sodium iodide
NAVSEA	Naval Sea Systems Command
Navy	U.S. Department of the Navy
NRC	U.S. Nuclear Regulatory Commission
NRDL	Naval Radiological Defense Laboratory

Acronyms and Abbreviations (continued)

PQCM	Project Quality Control Manager
PRSO	Project Radiation Safety Officer
QC	quality control
RASO	Radiological Affairs Support Office
RCT	radiological control technician
ROC	radionuclide of concern
ROICC	Resident Officer in Charge of Construction
RPM	Remedial Project Manager
RPP	*Radiation Protection Plan, Radiological Work Tasks, Remedial Action and Maintenance of Remedies at Hunters Point Naval Shipyard, San Francisco, California*
RWP	radiological work permit
RWQCB	California Regional Water Quality Control Board
SAP	sampling and analysis plan
SSHO	Site Safety and Health Officer
SU	survey unit
subpen	submarine pen
UFGS Section 01 35 26	*Unified Facilities Guide Specifications (UFGS) Section 01 35 26 Governmental Safety Requirements*
WMP	waste management plan
Work Plan	Radiological Characterization Surveys Work Plan

1.0 Introduction

This Radiological Characterization Surveys Work Plan (Work Plan) presents the tasks and procedures that will be implemented by Aptim Federal Services, LLC (APTIM) during the radiological characterization surveys of the Parcel F structures (submarine pens and finger piers), located at Hunters Point Naval Shipyard (HPNS), San Francisco, California (Figure 1). The characterization surveys are being performed for the U.S. Department of the Navy (Navy), Naval Facilities Engineering Command Southwest, under Contract No. N62473-17-D-0006, Contract Task Order (CTO) N62473-17-F-4550. Base Realignment and Closure Program Management Office West will manage the work elements under this CTO.

Based on the radiological operational history described in the *Final Historical Radiological Assessment Volume II, History and the Use of General Radioactive Materials, 1939-2003* (HRA; Naval Sea Systems Command [NAVSEA], 2004), the Navy determined that low-level radioactive contamination is potentially present at the submarine pens and the finger piers. This decision was presented in the *Final Basewide Radiological Removal Action, Action Memorandum—Revision 2006, Hunters Point Shipyard, San Francisco, California* (AM; Navy, 2006). The purpose of the AM was to document the Navy's decision to perform time-critical removal actions at areas throughout HPNS that could contain localized radioactive contamination and substantially eliminate identified exposure pathways to surrounding populations and nearby ecosystems.

The Navy identified the applicable or relevant and appropriate requirements for the HPNS removal actions, which were presented in Appendix A of the AM (Navy, 2006). The cleanup goals for localized radioactive contamination at HPNS presented in the AM were derived in consultation with federal and state regulators to meet the most conservative requirements at the time the AM was being written.

The HRA (NAVSEA, 2004) lists cesium-137 (^{137}Cs), plutonium-239 (^{239}Pu), radium-226 (^{226}Ra), and strontium-90 (^{90}Sr) as the radionuclides of concern (ROCs) for the Parcel F structures (Table 1). The radiological release criteria for each ROC are also provided in Table 1. For alpha measurements, the most restrictive release criterion for alpha-emitting ROCs is 100 disintegrations per minute (dpm)/100 square centimeters (cm^2) for ^{226}Ra and ^{239}Pu. For beta measurements, the most restrictive release criterion for beta-emitting ROCs is 1,000 dpm/100 cm^2 for ^{90}Sr.

The objective of this Work Plan is to describe radiological characterization surveys designed to provide results with sufficient quantity and quality to meet the requirements of a final status survey and achieve unrestricted release for Parcel F structures. The Parcel F structures include the submarine pens (Drydocks 5, 6, and 7 and associated Ship Berths 61, 62, 63, and 64; Figure 2) and the finger piers (Finger Piers 1, 2, and 3 and associated Ship Berths 23 through 28, 30 through 35, and 37 through 42; Figure 3).

1.1 Project Scope

The scope of the planned activities consists of the following elements:

- Develop the Work Plan and associated appendices
- Conduct radiological characterization surveys of the Parcel F structures (Figures 2 and 3)
- Prepare Parcel F characterization survey reports

1.2 Site Safety

Field activities will be conducted in accordance with the *Accident Prevention Plan, Radiological Work Tasks, Remedial Action and Maintenance of Remedies at Hunters Point Naval Shipyard, San Francisco, California* (APP/SSHP; APTIM, 2017a). Applicable federal and California Occupational Safety and Health Administration regulations and permit requirements will be followed, as well as the *Safety and Health Requirements Manual EM 385-1-1* (U.S. Army Corps of Engineers, 2014) and *Unified Facilities Guide Specifications (UFGS) Section 01 35 26 Governmental Safety Requirements* (UFGS Section 01 35 26; Naval Facilities Engineering Command, 2015).

1.3 Radiation Protection Program

The *Radiation Protection Plan, Radiological Work Tasks, Remedial Action and Maintenance of Remedies at Hunters Point Naval Shipyard, San Francisco, California* (RPP; APTIM, 2017b) defines the requirements for radiological protection support work performed by APTIM at HPNS. An overview of the performance of radiological hazard analysis and controls, analysis of smears, internal and external dosimetry, and other matters regarding radiation protection is presented in the RPP (APTIM, 2017b). For radiological activities, APTIM will invoke U.S. Nuclear Regulatory Commission (NRC) License 20-31340-01 and California State Radiological License 7889-07 to perform this work at HPNS. APTIM will also establish areas of control under a Memorandum of Understanding with the HPNS low-level radioactive waste Brokering Company and any other Navy contractors as required. The intent of the Memorandum of Understanding is to outline the general applicability and responsibilities of each entity as applicable to corresponding work scope and license compliance parameters.

APTIM's policy is that radiological work, including work with radioactive materials or ionizing radiation, be purposeful and performed in a manner that protects workers, members of the general public, and the environment. Exposures to ionizing radiation and releases of radioactive material shall be managed to reduce individual and collective doses to workers and the public and ensure that exposure is as low as reasonably achievable (ALARA). Work involving radiological hazards may not begin unless that work can be performed in a safe manner, compliant with rules and regulations. Moreover, APTIM endorses and applies ALARA principles. The ALARA principle is integrated in activities described in this Work Plan and will be implemented during the course of the work carried out under this Work Plan.

Project participants with the intent to enter a posted Restricted Area must successfully complete site-specific radiation worker training. The participants must also be briefed on the RPP (APTIM, 2017b), and sign acknowledgement that the participant has read and understands the requirements.

All employees working at the site have authorization to stop work if an unsafe condition exists or a safety procedure is being disregarded in accordance with *APTIM Management System* (AMS), AMS-710-05-PR-00400, “Stop Work Authority” (APTIM, 2017c).

1.4 Work Plan Organization

This Work Plan consists of 10 sections and provides descriptions of the specific activities involved in the implementation of the survey work. This Work Plan is organized as follows:

- Section 1.0, “Introduction”—Section 1.0 provides an introduction, project scope and schedule, site safety, radiological controls, and the Work Plan organization.
- Section 2.0, “Site Conditions and Background”—Section 2.0 presents the site location, description and history, and the nature and extent of contamination.
- Section 3.0, “Regulatory Framework”—Section 3.0 describes the regulatory process, project objectives, and anticipated waste streams.
- Section 4.0, “Project Requirements”—Section 4.0 describes the required supporting project documents.
- Section 5.0, “Survey Design”—Section 5.0 describes the process for survey design and data quality objectives (DQOs).
- Section 6.0, “Pre-Field Work Activities”—Section 6.0 describes permitting and notification requirements, meetings, mobilization, and site preparation activities.
- Section 7.0, “Characterization Surveys Field Work”—Section 7.0 describes field investigation activities, site restoration, decontamination, waste management, and demobilization activities.
- Section 8.0, “Project Management Plan”—Section 8.0 describes the key project personnel, document control, meetings and reports, and the project schedule.

- Section 9.0, “Reporting Requirements”—Section 9.0 describes the reporting requirements.
- Section 10.0, “References”—Section 10.0 includes a list of documents used to compile this Work Plan.

Appendices A through E—The Sampling and Analysis Plan (SAP), Contractor Quality Control Plan (CQCP), Waste Management Plan (WMP), the gamma scan minimum detectable concentration (MDC) basis, and responses to comments are included as Appendices A, B, C, D, and E, respectively.

2.0 Site Conditions and Background

This section presents the site location, site description and history, and the nature and extent of contamination.

2.1 Site Location

The HPNS is located in southeastern San Francisco on a peninsula that extends east into the San Francisco Bay (Figure 1). The HPNS consists of 866 acres: 420 acres on land and 446 acres under water in the San Francisco Bay. Parcel F comprises approximately 446 acres offshore of HPNS.

The Parcel F structures include the submarine pens and the finger piers. The submarine pens (Drydocks 5, 6, and 7 and associated Ship Berths 61, 62, 63, and 64) are located in Parcel F and extend from Parcel B-1 (Figure 2). The finger piers (Finger Piers 1, 2, and 3 and associated Ship Berths 23 through 28, 30 through 35, and 37 through 42) are located in Parcel F and extend from Parcel D-1 (Figure 3). The Parcel F structures extend a few feet inland from the water edge and include concrete structures, utility pads, vaults, and other infrastructure (e.g., open and closed manholes, buildings on the finger piers, and other debris).

2.2 Site Description and History

Submarine pen Drydocks 5, 6 and 7 and associated Ship Berths 61, 62, 63, and 64 were built in 1944 for submarine repair, and were also capable of housing destroyers and other relatively small vessels. Drydocks 5 and 7 are each approximately 420 feet long by 60 feet wide, and Drydock 6 is approximately 420 feet long by 75 feet wide. The drydocks were each equipped with a gate (caisson) that was hinged at the bottom that flapped down to allow the vessel to enter. Each drydock was dewatered by four 20,000 gallons per minute pumps. Two pumps were located at each side of the San Francisco Bay end of the dock (NAVSEA, 2004). Historical drawings show a suction tunnel running across the drydock between the two sets of pumps. Drydocks 5 and 7 could be dewatered in one hour with no ship in the dock using all pumps at full capacity. Drydock 6, due to its larger size, required approximately 1 hour and 20 minutes to dewater. The pumps are not currently visible at the site and are presumed to have been removed. The docks were flooded by means of two 3-foot hydraulically operated flooding valves located on each side of the San Francisco Bay end of the dock. Flooding times were 45 minutes for Drydocks 5 and 7 and one hour for Drydock 6. There are no utility drawings available for the submarine pens (subpens).

The following radiological operations were performed at Drydocks 5, 6, and 7 and associated Ship Berths 61, 62, 63, and 64:

- Decontamination of Operation Crossroads ships in Drydock 6, potential decontamination of Operation Crossroads ships in Drydock 5 and Drydock 7
- Ship repair (submarines)
- Naval Nuclear Propulsion Program operations in Drydock 6

The following radiological operations were performed at Finger Piers 1, 2, and 3 and associated Ship Berths 23 through 28, 30 through 35, and 37 through 42:

- Berthing of Operation Crossroads ships
- Berthing of YGN-73 radioactive waste disposal barge
- Berthing of Naval Radiological Defense Laboratory (NRDL) experimental barges and YAG-39 and YAG-40 (ships used to support and study the effects of nuclear and atomic weapons tests)

Radiological operations generally performed at HPNS that could impact the submarine pens and finger piers included the use of generally licensed radioactive material, including handling and refurbishment of radioluminescent devices. Other activities involving radioactive material included gamma radiography, and calibration of radiation detection instruments.

In 2012, the Navy performed a removal action that included Ship Berths 61 and 64 in the submarine pens. The objective of the removal action was to remove radiologically impacted over-water structures that were dilapidated, dropping debris into the San Francisco Bay, and the debris that presented hazards to navigation in the San Francisco Bay (ERS Joint Venture, 2012). Radioactive material was not encountered during the course of the removal action, and no radioactive waste was generated.

2.3 Nature and Extent of Contamination

A history of Navy radiological operations at HPNS is provided in the HRA (NAVSEA, 2004). Radioluminescent devices were used on ships and in shipyards to provide markers that could be seen under low-light conditions. These radioluminescent devices included ^{226}Ra or ^{90}Sr as a source of radioactivity to generate light using these devices. There is a low probability that intact radioluminescent devices could still be present at the submarine pens and the finger piers. However, it is more likely traces of radioactivity from damaged, discarded, or lost devices could be present on surfaces associated with the Parcel F structures, although the probability of residual radioactivity from radioluminescent devices is still low.

Drydocks and ship berths were decontaminated and surveyed following maintenance and decontamination of radiologically impacted ships. Sandblast material was removed and disposed of as described in Section 6.4.1 of the HRA (NAVSEA, 2004). After removal of the sand, the drydock floor was vigorously washed and the water pumped into the harbor. The drydocks were surveyed and met the criteria for release. ROCs from nuclear and atomic weapons tests would include a mixture of fission products, activations products, and actinides. ^{137}Cs and ^{239}Pu were selected as ROCs most likely to be present and most likely to be detected as contamination at HPNS. Radioactivity from contaminated ships is most likely to occur where contaminated ship surfaces could come into contact with drydocks or piers. Surveys of the drydocks following decontamination operations failed to identify areas of elevated radioactivity, so the probability of residual radioactivity from contaminated ships at the submarine pens or finger piers is low.

Radioactive wastes from NRDL and ship decontamination activities were loaded on barges at HPNS and transported for disposal in the ocean. Radioactive wastes included sandblasting residue from ship decontamination activities, as well as waste from NRDL laboratories and experiments (NAVSEA, 2004). Expected radiological waste constituents include a mixture of fission products, activation products, and actinides. ^{137}Cs and ^{239}Pu were selected as representative ROCs. Radioactive wastes were typically sealed in drums or other packages for transport, and may have been staged on piers or alongside ship berths prior to loading the waste onto the barges. The potential for residual radioactivity at the submarine pens and piers from leaking waste packages is low. The most likely location for residual radioactivity would be horizontal surfaces adjacent to ship berths where the waste packages could be staged prior to loading on the YGN-73 barge for disposal.

3.0 Regulatory Framework

In 1989, the U.S. Environmental Protection Agency (EPA) identified HPNS as a National Priorities List site. As a result, the Navy is conducting environmental work in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) (Title 42 United States Code Sections 9601 to 9675) at a number of sites at HPNS. As the lead agency, the Navy is working with EPA Region 9 and the California Department of Toxic Substances Control (DTSC) and the California Regional Water Quality Control Board (RWQCB) to develop and implement the remedial scope in this Work Plan. The Navy coordinates activities at HPNS with the regulatory agencies under the terms of a Federal Facilities Agreement. The Federal Facilities Agreement was prepared in 1990, revised in 1991, and signed by representatives of the Navy, EPA, DTSC, and the RWQCB in 1992. The Navy, EPA, DTSC, and RWQCB representatives are collectively referred to as the Base Realignment and Closure Cleanup Team for HPNS.

3.1 Regulatory Process

This Navy is directing this work under the U.S. Department of Defense Installation Restoration Program in accordance with the requirements of the CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan. This survey work will be performed in accordance with the AM (Navy, 2006). The work will be conducted in accordance with Section 121(e) of CERCLA (42 United States Code, Section 9621[e]), as amended, which states that no federal, state, or local permits shall be required for the portion of any removal or remedial action conducted entirely on site. Because the work under this Work Plan is executed to support a removal action and will be conducted entirely on site, permits are not required for this work. However, all substantive requirements will be met.

3.2 Project Objectives

The objectives for this action are to implement the AM (Navy, 2006) and protect public health and welfare and the environment, which are consistent with the National Oil and Hazardous Substances Pollution Contingency Plan requirements in Title 40 CFR, Part 300.415(b)(2). This action includes performing characterization surveys of the Parcel F structures and identifying radioactive contamination that exceed the release criteria presented in Table 1.

3.3 Anticipated Waste Streams

Several waste streams are anticipated to be generated during site activities. Non-radiological waste that are anticipated include, but are not limited to, the following:

- Refuse and debris
- Personal protective equipment

Low-level radioactive waste (LLRW) or low-level mixed waste that is anticipated include, but are not limited to, the following:

- Discrete radiological point sources
- Radiologically contaminated soil/sediment
- Refuse and debris
- Personal protective equipment
- Material and equipment used during the course of work

Waste management activities are described in the WMP provided in Appendix C of this Work Plan. The WMP has been prepared to address management, transportation, and disposal of the aforementioned waste streams. Radioactive waste, including any identified mixed waste, will be properly stored on site pending disposal by the HPNS Radiological Waste Broker under the direction of the Navy.

4.0 Project Requirements

Required project plans, including radiological work permits (RWPs), are discussed in this section.

4.1 Accident Prevention Plan/Site Safety and Health Plan

The APP/SSHP (APTIM, 2017a) was submitted under a separate cover. The APP/SSHP was prepared to support fieldwork in accordance with the *Safety and Health Requirements Manual EM 385-1-1* (U.S. Army Corps of Engineers, 2014) and UFGS Section 01 35 26 (Naval Facilities Engineering Command, 2015).

4.2 Radiation Protection Plan

The RPP (APTIM,2017b) was prepared under a separate cover. The RPP was prepared to support work performed by APTIM at radiologically impacted sites at HPNS included under this CTO. The RPP document requirements and standard operating procedures to ensure qualified personnel, proper radiological controls, and approved standard operating procedures are used to perform radiological work at the site.

4.3 Radiological Work Permits

The RWP serves as a tool in identifying radiological hazards for project tasks to be performed and for specifying hazard mitigation and control measures necessary to protect workers from the radiological hazards, including personal protective equipment required for the task(s). The RWPs will be generated in accordance with the RPP (APTIM, 2017b). Personnel assigned to site work will be required to read and sign the RWP acknowledging that they understand the requirements of the RWP prior to beginning work. The RWPs identify the requirements for entering, exiting, and conducting work in radiological areas.

4.4 Sampling and Analysis Plan

The Sampling and Analysis Plan (SAP) is included as Appendix A to this Work Plan. The SAP includes sampling methods, procedures, and quality control(QC)/quality assurance requirements to be followed during the execution of this CTO. The SAP was prepared to address the sampling associated with the gamma scanning, alpha/beta surveys, and sampling to be performed at site.

4.5 Contractor Quality Control Plan

The CQCP was prepared in accordance with UFGS Section 45 00.00 20 (Naval Facilities Engineering Command, 2017). This plan is included as Appendix B.

4.6 Waste Management Plan

A WMP was prepared to allow for proper storage, characterization, and disposal of liquid and solid waste generated during the field activities. This plan addresses management, anticipated stockpiling, handling/transportation, and disposal of the waste streams derived during the fieldwork. The WMP is included as Appendix C. APTIM will not dispose of radioactive waste. Radioactive material, if any, that is identified during field activities will be collected, segregated, and stored in appropriate containers per the RPP (APTIM, 2017b) for subsequent packaging and disposal by a certified waste broker under the direction of the Navy LLRW Disposal Program.

5.0 Survey Design

The objective of the radiological characterization surveys is to characterize potential residual radioactivity of the Parcel F structures. The surveys have been designed to support unrestricted release if no contamination is identified. A combination of scan surveys, static measurements at systematic and biased locations, and measurements of removable radioactivity at static measurement locations will be performed.

5.1 Classification and Survey Units

In accordance with the HRA findings (NAVSEA, 2004), which state the current potential for contaminated media including soil, groundwater, structures, drainage systems and surrounding air are low or none, the Parcel F structures are classified as Class 3 areas in a *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* (MARSSIM) framework (NRC et al., 2000). Class 3 areas are unrestricted in size and meet the following criteria: (1) impacted; (2) little or no potential for delivering a dose above the release criterion; and (3) little or no potential for small areas of elevated activity. This characterization survey has been designed such that if contamination is not found, the characterization survey is presented as a FSS to achieve unrestricted release.

The Parcel F submarine pens consist of three Class 3 survey units (SUs) (Figure 2), and the finger piers consist of three Class 3 SUs (Figure 3). SU locations, classifications, and descriptions are included in Table 2.

If radiological contamination is discovered during the survey, the Parcel F submarine pens and/or finger piers exceeding the release criteria listed in Table 1 will be re-surveyed as Class 1 areas. If no radiological contamination is discovered, the Parcel F structures will be recommended for unrestricted radiological release.

5.2 Radionuclides of Concern

As determined in the HRA, the ROCs for the Parcel F structures are ^{137}Cs, ^{239}Pu, ^{226}Ra, and ^{90}Sr (Table 1).

5.3 Reference Areas

The background reference area is a geographical area from which representative radioactivity measurements are performed for comparison with measurements performed in an impacted area. The reference area is an area that should have similar physical, chemical, radiological, and biological characteristics as the impacted area(s) being investigated, but that has not been identified as impacted.

5.3.1 Sitewide Soil Background Area

Reference area soil samples were obtained at the Building 526 reference area (Figure 1). Twenty samples were systematically collected from this area for reference area purposes. All 20 samples were sent to a U.S. Department of Defense Environmental Laboratory Accreditation Program accredited off-site laboratory (TestAmerica St. Louis) for analysis by gamma spectroscopy and use as reference area definitive data. Ten percent of the samples (two samples total) were also analyzed for ^{90}Sr and ^{239}Pu. Background activity for ^{226}Ra, based on the mean of the greater of the reported activity or method detection limit, was determined to be 0.633 picocuries per gram, placing the release criterion at 1.633 picocuries per gram of ^{226}Ra for final definitive data. The reference area gamma spectroscopy and ^{90}Sr results from the U.S. Department of Defense Environmental Laboratory Accreditation Program accredited off-site laboratory (TestAmerica St. Louis) are summarized in Table 3. If a new background dataset is collected and approved for Navy use, which may establish background concentrations for ROCs, that background dataset may be used in place of the existing dataset.

5.3.2 Survey Investigation Levels

The reference area behind Building 810 (Figure 1) will be used to establish gamma instrument-specific investigation levels (ILs). Reference data will be collected in similar matrix (i.e., concrete pad). If needed, additional reference areas may be established with the approval of the Navy. The same survey methods and equipment that will be used for conducting a survey area will be used for the background area data collection. Reference (background) area data and ILs will be provided to the radiological control technicians (RCTs) prior to the start of a survey for their use during data collection. Gamma scanning and static measurements collected from the reference area will be used to develop instrument-specific ILs for gamma walkover survey and gamma static measurements. Each IL is based on the instrument-specific mean background value plus 3 standard deviations of the mean. Scan and static data will also be collected with the RS-700 system to establish background data for the spectral analysis process. The IL for the alpha/beta scanning will be based on the release criteria established in the AM (Navy, 2006) and presented in Table 1. Alpha/beta material-specific backgrounds will be established for each instrument based on measurements performed in the reference area.

5.4 Data Quality Objectives

DQOs are qualitative and quantitative statements developed to define the purpose of the data collection effort, clarify what the data should represent to satisfy this purpose, and specify the performance requirements for the quality of information to be obtained from the data. These outputs are used to develop a data collection design that meets all performance criteria and other design requirements and constraints. EPA has specified a seven-step process to develop DQOs (EPA, 2006) which was adapted for use in MARSSIM (NRC et al., 2000). The DQOs for this project are summarized in the following subsections.

5.4.1 Step One—State the Problem

The HRA (NAVSEA, 2004) identifies the Parcel F submarine pens and finger piers structures as radiologically impacted. Therefore, characterization surveys need to be completed.

5.4.2 Step Two—Identify the Decision

The decision to be made is as follows: "Are levels of residual radioactivity present at the Parcel F structures that would prevent unrestricted release?"

The following alternative actions will result from the resolution of the principle study question:

- If residual radioactivity is found during the radiological surveys at levels that would prevent unrestricted release of the site, then the Navy will be notified of the presence of residual radioactivity to determine the appropriate next steps for further investigation and the areas will be re-surveyed as Class 1 areas.
- If residual radioactivity is not found at levels that would prevent unrestricted release of the site during the radiological surveys, then no further investigation will be performed and the area will be recommended for unrestricted use.

5.4.3 Step Three—Identify Inputs into the Decision

Radiological surveys will include

- Surface gamma scanning surveys for 100 percent for accessible surfaces of the submarine pens and finger piers
- Surface alpha/beta scanning surveys for 25 percent for accessible surfaces of the submarine pens and finger piers
- Static measurements for alpha/beta at a statistically determined number of random locations to estimate the average level of residual radioactivity
- Static measurements of alpha/beta or gamma activity at biased locations (as appropriate) to investigate survey results exceeding project ILs
- Measurements of removable alpha/beta activity collected at locations based on the highest static measurements of alpha/beta activity

In addition, solid samples of specified materials may be collected to investigate sources of elevated count rates, if required.

5.4.4 Step Four—Define the Study Boundaries

The spatial boundaries for this study are the Parcel F submarine pens (Figure 2) and the Parcel F finger piers (Figure 3). The vertical boundary of the project area extends from the top of the drydock, berth, or pier to the low tide line. The horizontal boundary is defined by the concrete surfaces forming the submarine pens and finger piers.

5.4.5 Step Five—Develop a Decision Rule

If the mean results of the survey are consistent with the release criteria (Table 1), the data will be used to support free release of the structures.

If the mean results of the survey exceed the screening criteria, the site will be further investigated as described in the decision rules.

- The IL for gamma scan measurements is the average of gamma scan measurements for a similar material in an appropriate background area plus three standard deviations. If a gamma scan survey result exceeds the IL, that location will be included in the surface area covered by the alpha/beta scanning survey. The IL for gamma scan measurements will be determined separately for the RS-700 and gamma scintillator handheld radiation detection instruments.

- The IL for alpha/beta static measurements is 50 percent of the most conservative (i.e., lowest) release criteria provided in Table 1 for alpha and beta-emitting radionuclides. If an alpha or beta static count result exceeds the corresponding IL, the static count will be repeated to confirm the result. If the confirmatory result exceeds the corresponding IL, the APTIM Project Manager and the Project Radiation Safety Officer (PRSO) will be notified that an area of elevated alpha or beta activity has been identified. The APTIM Project Manager and/or the PRSO will notify the Navy.

- The IL for removable alpha or beta activity is the most conservative (i.e., lowest) release criteria provided in Table 1 for alpha and beta-emitting radionuclides. If a removable measurement result for alpha or beta exceeds the IL, a notification will be made to the APTIM PRSO. The APTIM Project Manager and/or the PRSO will notify the Navy.

5.4.6 Step Six—Specify Limits on Decision Errors

Limits on decision errors are set at 5 percent.

5.4.7 Step Seven—Optimize the Design for Obtaining Data

Operational details for the radiological survey process have been developed, as further discussed in Section 7.0 of this Work Plan. The theoretical assumptions are based on guidelines contained in MARSSIM (NRC et al., 2000).

5.5 Survey Instrumentation

Commercially available radiation detection and measurement instrumentation will be selected based on reliable operation, detection sensitivity, operating characteristics, and expected performance in the field. Radiological survey instruments suitable for the physical and environmental conditions at the site have been selected and are provided in Table 4. The instruments and measurement methods selected are suitable for detection of project ROCs

(^{137}Cs, ^{239}Pu, ^{226}Ra, and ^{90}Sr) with sensitivity (i.e., detection limits) that are below applicable survey criteria. Instrument capabilities will be verified by the PRSO.

APTIM operational procedures are included in the RPP and will be used for all field instruments to verify the equipment is operating properly and used correctly in the field to produce accurate and reliable data. At a minimum, calibrations of radiation detection instruments will be performed annually and after major repairs. Field instrument checks will verify instrument response and will be performed at the beginning and end of each day of use. Calibration will be performed by a qualified vendor with National Institute of Standards and Technology traceable sources. If the field instrument checks reveal the instrument is outside established response tolerances, the instrument will be marked out of service. If necessary, the instrument will be returned to the manufacturer for immediate repair and servicing. Surveys performed with an instrument that fails post or pre-use operational (background and/or source response) checks will be evaluated by the APTIM PRSO for re-performance of the survey with another equivalent instrument. At a minimum, calibration records will contain the following information:

- Instrument name and identification number (e.g., model and serial number)
- Manufacturer
- Date of calibration
- Calibration due date
- Name of company and person performing the calibration
- Calibration points
- Results of the calibration
- Calibration source documentation (serial number, certification, radionuclides, etc.)

5.5.1 Instrument Setup and Quality Control

Prior to initial instrument use, a minimum of 10 measurements will be collected using a source representative of the radiation types and energies of interest. A minimum of 10 one-minute measurements will be collected with the source removed to determine the instrument’s expected response to ambient background. Background will be monitored qualitatively to assess daily variations that may have impact instrument MDC calculations. From the initial source measurements, the mean of the observed count rate will be calculated. The acceptance criterion will be ± 20 percent of the mean of the initial source counts. Source checks will be monitored using a control chart, with control limits set at ± 20 percent of the average count rate. For the alpha/beta smear counter, the acceptance criterion for each channel will set at ± 2 or 3 standard deviations from the mean, as follows: If an alpha/beta counting system channel falls outside

2 standard deviations of the mean but is within 3 standard deviations of the mean, the source check will be repeated. A Chi-square test will also be performed according to procedure to maintain QC compliance for Ludlum Model 2929/3030 (smear counter) and Ludlum Model 2360 ratemeter/scaler (direct measurement).

5.5.2 Gamma Instrumentation

Gamma surface scans will be performed using the RS-700 as a towed array. A 3-inch by 3-inch sodium iodide (NaI) detector will be used for areas that are not accessible to the RS-700.

The RS-700 consists of an RSI RS-701 integrated controller and data acquisition system, a digital gamma ray spectrometer/multi-channel analyzer, a data controller, two RSX-1 4-liter (256 cubic inch) NaI gamma scintillation detectors, an internal global positioning system (GPS), and an external high-resolution Trimble Pro XH GPS receiver. The system is operated using the RS-700 RSI "RadAssist" software, which displays real-time data collection, both as a NaI spectrum as well as the count rates. Radiation and location information are collected by the system at a very high data transfer rate (nominally one data point per second), and stored in an uncorruptible data file for real-time feedback and data validation/post-processing. The system operator receives real-time feedback using waterfall plots of total response and geo-referenced mapping of relative radiation concentrations.

The RS-700 may also be used to assess follow-up locations, using a 1-minute or greater static count and spectral analysis to compare the activity at a specific point to background. In this case, the net spectrum will be plotted and the critical levels assessed for ROC-specific energy ranges to determine if there is any activity present above background. Critical levels, as defined in the MARSSIM Section 6.7.1, represent thresholds above which net counts are statistically greater than background (NRC et al., 2000). If RS-700 static measurements identify any elevated locations, biased samples will be collected.

The handheld gamma scan equipment consists of a Ludlum Model 44-20 3-inch by 3-inch NaI gamma scintillation detector coupled with a Ludlum Model 2221 ratemeter/scaler, or equivalent. Position correlation of the gamma scan results is provided by a high-resolution GPS receiver.

Static measurements, if required as discussed in Section 5.6, will be collected using a Ludlum Model 44-20 3-inch by 3-inch NaI gamma scintillation detector coupled with a Ludlum Model 2221 ratemeter/scaler, or equivalent, handheld instrument.

5.5.3 Gamma Surface Scan Minimum Detectable Concentration

The gamma surface scan MDC was determined for identifying intact deck markers containing ^{226}Ra or ^{90}Sr attached to the surface being investigated (Appendix D). The assumptions used to calculate the gamma surface scan MDC are the same for the RS-700 and the 3-inch by 3-inch

NaI scintillation detector. Deck markers are assumed to have an active area of 7/8-inch with a 3/8-inch plastic cover. The scan speed for the RS-700 is 1 meter per second (m/s) or less with the detector suspended 10 centimeters (cm) (4 inches) above the surface being investigated. The minimum detectable activity (MDA) for a ^{226}Ra deck marker on the surface of the Parcel F structures is well below that experienced when scanning soil for low-level radiological objects buried beneath the surface.

The scan speed for the 3-inch by 3-inch NaI detector is 0.5 m/s with the detector suspended 15 cm (6 inches) above the surface being investigated. The gamma scan MDA for a ^{226}Ra deck marker on the surface is well below that experienced when scanning soil for low level radiological objects buried beneath the surface.

5.5.4 Alpha and Beta Instrumentation

Measurements of total and removable alpha and beta radiation will be performed over 25 percent of accessible surface area as part of this survey. Total alpha and beta radiation will be measured using scans and static measurements using a Ludlum 43-37 gas proportional detector connected to a Ludlum Model 2360 ratemeter/scaler, or equivalent. Removable alpha and beta radiation will be measured using smears counted using a Ludlum Model 2929 sample counter, or equivalent. The sample counter uses a dual phosphor detector for radiation detector.

5.5.5 Alpha and Beta Surface Scan Minimum Detectable Concentration

The scan speed for detecting alpha radiation at the release criterion for ^{226}Ra of 100 dpm/100 cm^2 was calculated using the guidance from MARSSIM Appendix J (NRC, 2000) supplemented with additional information from Radiological Affairs Support Office (RASO) (RASO, 2013). The scan speed using an instrument efficiency with the detector on contact with the surface is 4 seconds, or approximately 1 centimeter per second (cm/sec). Using a lower instrument efficiency for a detector raised off the surface allowing the detector to move over the surface results in a scan speed on the order of 0.25 cm/sec., or 3 seconds per cm.

Scanning at 0.25 cm/sec is not logistically practical. Therefore, a series of static counts will be performed to provide alpha and beta surface scan measurements. The static counts will provide the equivalent detection efficiency to scanning at 0.25 cm/sec. The detector will be positioned in contact with the surface to be surveyed to provide the maximum instrument efficiency. A preset count time of 6 seconds (0.1 minutes) will be used for the count time, which is slightly greater than the minimum required count time of 4 seconds calculated for alpha activity at 100 dpm/100 cm^2. Once the static count is completed, the results are recorded and the detector re-positioned adjacent to the first count position, providing 100 percent coverage with the adjacent counts.

The minimum detectable net count for alpha was calculated as 2.6 counts in 6 seconds. This number was rounded up to 3 counts in 6 seconds. The minimum detectable net count in 6 seconds for beta was calculated as 21.3 and was rounded up to 22 counts in 6 seconds. This means that an alpha count of 3 counts or more above background in 6 seconds indicates the potential for residual alpha radioactivity exceeding the release criteria. A beta count of 22 or more counts above background in 6 seconds indicates the potential for residual beta radioactivity exceeding the release criteria. Converting these numbers into activity units for the Ludlum Model 43-37 gas proportional detector, the scan MDC for alpha is 86 dpm/100 cm^2 and the scan MDC for beta is 473 dpm/100 cm^2. Both values are less than the corresponding release criteria listed in Table 1; therefore the series of 6-second static scans meets the objectives of the survey. Instrument characteristics for the Ludlum Model 43-37, including background and total instrument efficiency, are provided in Table 5.

5.5.6 Alpha Beta Static Minimum Detectable Concentration

Integrated static alpha and beta activity measurements will be performed using a Ludlum Model 43-37 gas proportional detector during scans. A Ludlum Model 43-68 gas proportional detector may be used in areas inaccessible to the large area detector. The *a priori* MDCs for the investigation of the Parcel F structures were determined using the following equation, which is used to calculate instrument MDC in units of dpm/100 cm^2 when the background and sample are calculated for the same time interval:

$$MDC = \frac{3 + 4.65\sqrt{R_B T_B}}{\varepsilon_i \varepsilon_s \frac{W_A}{100} T_B}$$

Where:

3+4.65=constant factor provided in MARSSIM

R_B=background count rate in counts per minute

T_B=background count time in minutes

ε_i=instrument efficiency in counts per particle

ε_s=contaminated surface efficiency in particles per disintegration

W_A=active area of the detector in cm^2

Two-minute static measurements will be performed when using the Ludlum Model 43-3. Based on the backgrounds and efficiencies experienced using the Ludlum Model 43-37, the *a priori* MDC for alpha is 21.5 dpm/100cm^2 and for beta is 184 dpm/100cm^2. Five-minute static measurements will be performed when using the Ludlum Model 43-68. Based on the backgrounds and efficiencies experienced using the Ludlum Model 43-68, the *a priori* MDC for alpha is 32 dpm/100cm^2 and for beta is 202 dpm/100cm^2.This achieves sufficient detection to meet the release criteria shown in Table 1 and the ILs identified in the DQOs. Table 5 presents the static measurement sensitivity assumptions.

5.6 Gamma Count Rate Surveys

The gamma count rate survey of surface areas is performed in two stages. The first stage is a gamma count rate scan conducted over 100 percent of the accessible area using the RS-700 system or a Ludlum Model 44-20 and Ludlum Model 2221 (or equivalent) handheld instrument in areas inaccessible to the RS-700 system, consistent with the requirements for a MARSSIM survey (NRC et al., 2000). The data collected during the gamma scan are evaluated and if all readings are below the instrument specific gamma scan IL, or otherwise do not indicate the presence of an anomaly (e.g., via Z-score analysis, spatial plots, or other statistical analysis), the second stage is not required.

If the count rate exceeds the instrument specific gamma scan IL or indicates that further investigation is warranted, the second stage is an additional survey and possible material sampling at the location and adjacent area where the count rate exceeded the scan instrument specific scan IL and nearby areas. Biased gamma static measurements will be collected as part of the second stage of the survey.

Static measurements will consist of reacquiring the location of the elevated gamma count rate and conducting a 1-minute gamma static count using a Ludlum Model 44-20 3-inch by 3-inch NaI gamma scintillation detector coupled with a Ludlum Model 2221 ratemeter/scaler, or equivalent, handheld instrument. A high-resolution GPS receiver will record all gamma scan, static, and biased locations. The RS-700 has an internal GPS system, which displays real-time data collection. An additional GPS receiver will be used to verify locations of interest using handheld meter Ludlum Model 2221 coupled with Ludlum Model 44-20 NaI detector for the static and biased locations. The nearby area will be resurveyed to assess if the elevated gamma scan reading is due to a point source or distributed radioactive material. If the gamma static (1 minute) count is less than the instrument specific static IL and there is no evidence of a point source, further survey investigation is not required.

If the gamma static measurements are below the instrument specific IL, but there is a cluster of elevated gamma scan readings that exceed the gamma scan instrument specific IL, biased sample(s), depending on the size of the area, may be collected to determine the nature and extent of contamination present.

The RS-700 may also be used to assess follow-up locations, using a 1-minute or greater static count and spectral analysis to compare the activity at a specific point to background. In this case, the net spectrum will be plotted and the critical levels assessed for ROC-specific energy ranges to determine if there is any activity present above background. Critical levels, as defined in the MARSSIM Section 6.7.1, represent thresholds above which net counts are statistically greater than background (NRC et al., 2000). If RS-700 static measurements identify any elevated locations, biased samples will be collected.

If the static gamma count rate is less than the instrument specific static IL and there is no evidence of a point source or distributed source or the RS-700 spectral analysis does not identify any locations statistically above background, no further action is required. If radiological contamination is indicated, it will be addressed as described in Section 5.8.

5.7 Alpha and Beta Surveys

Alpha and beta scanning surveys will be performed on 25 percent of the accessible areas, and static measurements will be collected for the 54 systematic locations and based on the biased locations throughout the SUs by using Ludlum Model 2360.

5.7.1 Alpha and Beta Scan Measurements

As discussed in Section 5.5.5, scanning at a speed slow enough to meet RASO guidance for conducting alpha scans for radium (0.25 cm/sec) is difficult to perform in the field. For this project, six-second static counts will be performed to cover the necessary area (25 percent of accessible surfaces). This measurement will achieve the same level of detection as slow scanning.

Alpha and beta static scans will be performed over 25 percent of the area of each SU. Preference will be given to potential contamination concentration areas such as berthing locations, concrete joints and cracks, and drainage locations. Locations that exceeded the gamma scan IL will be included in these scans.

5.7.2 Alpha and Beta Static Measurements

The survey design requires the performance and evaluation of data from static measurements performed at random locations across each SU. Fifty-four two-minute static measurements will be collected at random locations within each SU. The random locations will be selected through the use of a map and random number generator. Any location that exceeds the IL will be marked with paint and further investigated.

5.7.3 Number of Alpha and Beta Measurements

The lower bound of the gray region was set equal to the most conservative release criterion for alpha activity, 100 dpm/100 cm^2, and beta activity, 1,000 dpm/100 cm^2.

The lower bound of the gray region was set equal to the estimated average alpha activity for concrete in the reference area, 40 dpm/100 cm^2, and average beta activity for concrete in the reference area, 400 dpm/100 cm^2. These estimates are based on twice the static MDC for the Ludlum Model 43-37 gas flow proportional counter probe detector, rounded to one significant digit. Concrete is expected to have the highest reference area concentration of any material in the Parcel F structures, and these estimates are expected to be higher than the actual values determined during surveys of the reference area.

The variability (σ) of alpha activity in the survey area was set equal to the estimated average alpha and beta activity for concrete in the reference area to design the survey.

The tolerable decision error rate for Type I and Type II decision errors was set equal to 0.05 (see DQOs, Section 5.4).

The relative shift was calculated as 1.5 for both alpha and beta static measurements per MARSSIM Section 5.5.2.2 as follows:

Relative shift for alpha measurements:

$$\frac{\Delta}{\sigma} = \frac{UBGR - LBGR}{\sigma} = \frac{100 - 40}{40} = 1.5$$

Where:

Δ/σ = relative shift

UBGR=upper bound of the gray region

LBGR=lower bound of the gray region

σ=variability in radionuclide concentrations or activity levels

Relative shift for beta measurements:

$$\frac{\Delta}{\sigma} = \frac{UBGR - LBGR}{\sigma} = \frac{1{,}000 - 400}{400} = 1.5$$

Where:

Δ/σ = relative shift

UBGR=upper bound of the gray region

LBGR=lower bound of the gray region

σ=variability in radionuclide concentrations or activity levels

MARSSIM Table 5.3 lists a minimum of 18 data points for a survey design with a relative shift of 1.5, Type I error rate of 0.05, and Type II error rate of 0.05. Although a minimum of 18 static alpha and beta measurements is determined using this approach, additional static measurements are necessary to meet the RASO guidance to increase the density of static measurements by a factor of 3 when basing the alpha detection probability on the 300 dpm/100 cm^2 hotspot limit. Fifty-four alpha/beta static measurements will be collected per SU. In addition, collection of static measurements at this frequency will provide a high degree of confidence that the surveyed surfaces are fully characterized. The assumptions regarding the number of measurements will be evaluated during the field effort and additional static measurements will be collected as required.

5.8 Remediation Approach and Radiological Object Management

Any time a radioactive anomaly is confirmed during radiological surveys, the location will be marked or flagged and GPS/grid coordinates will be recorded. The field survey team or the data group analyzing collected field information will notify the PRSO. Routine findings will be reported on the daily radiological site report provided to RASO and the Navy Remedial Project Manager (RPM). APTIM will report anomalies confirmed to be radioactive material related to historical Navy activities to RASO and the RPM.

6.0 Pre-Field Work Activities

Pre-field work activities are discussed in the following subsections.

6.1 Permitting and Notification

APTIM will obtain all necessary authorizations from the HPNS Caretaker Site Office (CSO) and the Resident Officer in Charge of Construction (ROICC) for performing the work at the Parcel F structures. Prior to initiation of field activities for the submarine pens and finger piers, APTIM will notify the Navy RPM, ROICC, CSO, University of California- San Francisco personnel, appropriate fire department personnel, and HPNS security as to the nature of the anticipated work.

Notifications will be made by APTIM to California Department of Public Health and the NRC at least 14 days prior to initiation of activities involving the radiological materials licenses. Additional notifications required by regulatory agencies for specific activities conducted under this Work Plan will be addressed in the corresponding subsections and appendices of the Work Plan, and in the APP/SSHP (APTIM, 2017a).

6.2 Pre-Construction and Mutual Understanding Meeting

A pre-construction and mutual understanding meeting will be held prior to mobilization of equipment and personnel. The purpose of the meeting will be to discuss project-specific topics, roles, and responsibilities of all project personnel, project schedule, health and safety concerns, and other topics that require discussions before field mobilization. The pre-construction meeting will be attended by representatives of the following:

- Navy (RPM, RASO, ROICC, CSO, others as applicable)
- APTIM (Project Manager, Site Construction Manager, Project Quality Control Manager [PQCM], PRSO and Site Safety and Health Officer [SSHO])
- Subcontractors as appropriate

6.3 Construction Quality Control Meetings

A contractor QC meeting will be held on a weekly basis throughout the course of fieldwork. At a minimum, the ROICC and the PQCM will attend this meeting. The Navy RPM, RASO, APTIM site personnel, subcontractors and vendor representatives, and Navy subcontractor personnel will also attend as appropriate.

6.4 Health and Safety Meetings

Daily tailgate safety meetings will be held before starting work. Field staff, including subcontractors, will attend these meetings and sign a tailgate safety meeting form. The meetings will be held by the SSHO, or his or her qualified designee, and will cover various safety issues. Any subcontractor, inspector, agency, or Navy personnel that visit the site during the course of the day will be required to review and sign the tailgate form prior to entering the work site.

6.5 Mobilization

Mobilization activities will include site preparation, movement of equipment and materials to the site, and orientation and training of field personnel. Site-specific training will include radiological safety awareness. At least two weeks prior to mobilization, the appropriate Navy personnel, including the Navy RPM, ROICC and CSO, will be notified regarding the planned schedule for mobilization and site characterization activities. APTIM personnel and subcontractors will acquire badges by the San Francisco Redevelopment Agency during mobilization.

Upon receipt of the appropriate records and authorizations, field personnel, temporary facilities, and required construction materials will be mobilized to the jobsite. The temporary facilities will include restroom(s), hand washing station(s), security fencing, and one or more secure storage (conex) boxes for short and long-term storage of materials, if needed.

6.6 Site Preparation

Site preparation activities are discussed in the following subsections.

6.6.1 Temporary Construction Facilities

Work performed in or near roadways will be coordinated with the Construction Manager, local tenants, and other site users to implement appropriate traffic control and road closures as needed for site personnel safety. Temporary facilities to be mobilized to the site will include restroom(s), hand washing station(s), security fencing, and one or more secure storage (conex) boxes for short and long-term storage of materials, if needed. A project sign and safety sign will be erected at the site.

6.6.2 Field Observations and Photographic Documentation

Field observations will be recorded in the project logbooks and daily reports. Photographs of the site will be collected during field operations. Electronic versions of the photographs will be sorted by date and accompanied by a Project Photographic Log providing the date, location, and a description of the activities shown in each photo will be developed and kept in the electronic project file.

Prior to beginning radiological surveys of the Parcel F structures, a Professional Engineer will visually inspect and structurally assess the subpens and finger piers. The expected loads include personnel and radiological equipment, including the RS-700 system attached to an all-terrain vehicle for the drive over gamma scanning. No heavy equipment or passenger vehicles will be driven on the subpens and piers.

6.6.3 Material Handling and Storage Areas

Radioactive waste will be minimized by compliance with contamination control work practices combined with survey practices. Radiological areas and postings are further described in the RPP (APTIM; 2017b). No radiologically controlled area is planned for this work effort. If discrete sources or areas of elevated radioactivity requiring additional radiological posting are found during the radiological characterization surveys, the APTIM PRSO will be immediately notified by the RCTs. The PRSO will then notify the Navy. The APTIM PRSO will oversee discrete object extraction, packaging, characterization and transport at the direction of the Navy. Any additional radiological posting required for this work effort will be coordinated through the APTIM PRSO, including development of any required RWPs.

If a radiologically controlled area is established as part of this work effort, field records will be maintained for waste generation activities. Field data records or daily reports will be signed and dated by the person entering the data. At a minimum, the following information will be recorded:

- Description of waste-generating activities
- Location of waste generation (including depth, if applicable)
- Type and volume of waste
- Date and time of generation
- Description of waste sampling
- Name of designee at time of generation
- Photographs of anomalies
- Radiological survey data
- Radiological dose readings on contact and at 30 cm from the waste container

6.7 Traffic Control

Traffic impacts are expected to be minimal during the characterization survey field work. Traffic control is not required during this work effort for the Parcel F structures because the structures are located within fenced areas and are not located near roads. A sufficient area for parking will be provided to all passenger vehicles to support the work effort. On-street parking will be prohibited for all vehicles associated with the field work activities to maintain normal access and clear lanes.

7.0 Characterization Surveys Field Work

This section describes the specific field work activities and procedures.

7.1 Radiological Characterization Survey of Submarine Pens and Finger Piers

The objective of the radiological characterization survey is to measure levels of residual radioactivity to support a decision regarding further investigation or unrestricted release for Parcel F structures. A combination of scan surveys, static measurements at random and biased locations, and measurements of removable radioactivity at static measurement locations will be performed.

7.1.1 Gamma Scan Surveys

Gamma scan surveys will be performed to identify areas of elevated gamma radioactivity that could result from residual radioactivity from radioluminescent devices or other sources of gamma radiation. Areas of elevated gamma activity will be included in the areas covered by the alpha and beta scan surveys.

The gamma scan surveys will be performed for 100 percent of the accessible areas for SUs 1 through 6 using the RS-700 or a Ludlum Model 44-20 3-inch by 3-inch NaI gamma scintillation detector coupled with a Ludlum Model 2221 ratemeter/scaler (or equivalent) handheld instrument in areas inaccessible to the RS-700. Figures 4 through 9 show the boundaries for each SU. Table 2 provides SU details and description.

Submarine pens Berths 62 and 63 are isolated areas and physically separated by water from the adjacent submarine pens (Photo 1).

The Finger Pier manholes and metal grate areas will not be accessed during the gamma scan surveys (see Photo 2). The Finger Pier subsurface areas are not considered impacted based on the site history (see Sections 2.2 and 2.3 of this Work Plan).

Horizontal surfaces will be scanned using the RS-700 with the detector suspended 10 cm (4 inches) over the surface being investigated at a scan speed of 1 meter per second (m/s) or less. The scan MDC is provided in Appendix D.

For vertical surfaces of the drydocks and areas inaccessible to the RS-700, a Ludlum Model 44-20 3-inch by 3-inch NaI gamma scintillation detector coupled with a Ludlum Model 2221 ratemeter/scaler (or equivalent) will be used to perform the scan survey. The 3-inch by 3-inch NaI detector will be suspended 15 cm (6 inches) over the surface being investigated, moving at a speed of 0.5 m/s or less. Vertical surfaces greater than 6 feet may expose personnel to falls greater than 6 feet. Appropriate personal protective equipment and engineering controls will be used to perform the work safety as described in the APP/SSHP (APTIM, 2017a) and may include fall protection, personal flotation devices, and barriers. If practical, the detector will be suspended from a pole at a distance approximately 15 cm (6 inches) from the vertical surface. Using appropriate safety controls, the RCT will walk at a rate of 0.5 meters per second or less along the subpen, maintaining the detector at a consistent height while also maintaining a distance of approximately 15 cm (6 inches) from the vertical surface. The gamma count rate and the GPS position will be recorded. Once the entire length of the vertical surface has been surveyed, the detector will be lowered approximately 30 cm (12 inches) to continue the gamma scan of the vertical surface at the new height. This process will be repeated until the entire vertical surface has been scanned.

At a minimum, scan data will be processed as follows:

- The measurements will be plotted as color-coded filled contours for visual review and evaluation.
- The mean and standard deviation of each SU will be calculated.
- The location of the highest gamma count rate per SU will be determined.
- The difference between each data point and the average of all data points will be calculated and divided by the standard deviation of the SU measurement set. This will convert the measurements to multiples of the standard deviation above or below the average count rate of the SU (z-scores). The z-scores will be plotted as color-coded filled contours for visual review and evaluation, where the color-coding will be based on multiples of SU standard deviation.
- Areas exhibiting a z-score greater than three will be further investigated in comparison to the IL. The geospatial plot will also be visually inspected to identify anomalies in the distribution of measurement data.

Photograph 1
Survey Unit 3 (Ship Berths 62 and 63)

7.1.2 Alpha and Beta Surveys

Alpha and beta surveys will include scans, static measurements, and smear measurements for Class 3 areas consistent with MARSSIM guidance (NRC, et.al, 2000) for Class 3 surveys. Alpha and beta static scans will be performed over 25 percent of the area of each SU. Debris will be relocated as necessary to complete these scans. Figures 4 through 9 shows the boundary for the SUs. The areas where the alpha/beta measurements will be performed may be adjusted as needed to include locations where the gamma scan results exceed the corresponding gamma IL.

Manholes, grates, and components of the suction and discharge system will be investigated during the characterization survey of Drydocks 5, 6, and 7. Each manhole will be opened and alpha/beta measurements will be collected to the extent practicable. Standing water has been observed in the manholes at low tide and may limit accessible surfaces. Alpha/beta scanning (as practicable), a minimum of one static measurement and one smear measurement will be collected from each accessible manhole. Accessible surfaces of discharge outlets located on the sidewalls of the drydocks will be investigated and surveyed. Alpha/beta scanning (as practicable), one static measurement and one smear measurement will be collected from each accessible outlet. The measurements may be biased to visible staining based on the direction and professional judgement of the PRSO. If the outlet impeller (or similar equipment) is safely accessible, alpha/beta scanning (as practicable), one static measurement, and a smear sample will be collected from the impeller. If material is available, sediment samples will be collected and submitted to the off-site laboratory for analysis in accordance with Section 7.2 of this Work Plan. Other components of the discharge system (i.e., metal plates and piping) will be visually inspected in the field, and surveyed as practicable. This inspection may include cutting or sawing activities for accessing field-identified discharge piping, manhole covers locked or welded in place, or other plates or covers limiting access to areas requiring survey. Scans, static measurements, and smear measurements will be collected from accessible surfaces as practicable. Confined space entry and heavy lifts are not anticipated for this work; personnel will not enter manholes or other confined spaces.

The alpha/beta static measurements will be performed using portable contamination survey instruments specifically, the Ludlum Model 43-37 gas flow proportional “floor monitor” detector (or equivalent) coupled with a Ludlum Model 2360 scaler/ratemeter (or equivalent) (Table 4). If required, a Ludlum Model 43-68 gas flow proportional detector (or equivalent) small area detector may be used to perform static measurements in areas not accessible to the Ludlum Model 43-37 large area detector (Table 4). The scaler/ratemeter will be set to a two-minute count time. At the start of each measurement, the RCT will position the detector, and begin the two-minute count. At the completion of each two-minute count, the alpha and beta result will be recorded. The IL for the alpha and beta static measurements will be developed and used as described in the decision rules in Section 5.4 of this Work Plan. The release criteria were established from the AM (Navy, 2006) and are presented in Table 1.

Two-minute static measurements will be collected at 54 random locations per SU as discussed in Section 5.7 of this Work Plan, and as part of investigations of scanning results exceeding the IL, as needed. Smears will be collected at each location where a total alpha and total beta static reading is taken. Smears may be qualitatively field checked to identify gross contamination with the Ludlum Model 2360 with a Ludlum Model 43-68 (or equivalent) detector. This will assist in identifying the extent of removable contamination. Smears will be quantitatively counted with a Ludlum Model 2929 or Ludlum Model 3030 sample counter located at the APTIM project office.

7.1.3 Sampling

Samples (sediment or material) may be collected as required to support the characterization of locations with identified elevated activity, based on the elevated results from the gamma scanning and/or alpha/beta survey (if any).

Photograph 2
Finger Pier Manholes and Buildings Structures

7.2 Radiological Analysis

Material samples, if required to further support the characterization of the finger piers and subpens, will be analyzed for ^{137}Cs and ^{226}Ra by gamma spectroscopy analysis and ^{239}Pu by alpha spectroscopy in accordance with the SAP (Appendix A to this Work Plan). Samples will also be analyzed for ^{90}Sr if there is a reason to suspect ^{90}Sr contamination (i.e., increased beta activity that is not attributed to another beta emitter as determined by laboratory analysis, the presence of ^{239}Pu, or the presence of ^{137}Cs). Gamma spectroscopy data will be reported by the off-site laboratory after an initial 7-day and following the 21-day ingrowth period. If the analytical results of the material indicate that any of the ROCs exceed their respective screening criterion (Table 1), the material is considered to be radiologically contaminated and may require additional remedial actions following consultation with the Navy.

7.3 Site Restoration

Restoration of Parcel F structures following the characterization survey effort is not expected or required. Any surface sample locations (i.e., core borings) will be restored in kind with concrete patching to prevent further weathering/destruction of the area sampled.

7.4 Decontamination and Release of Equipment and Tools

Equipment and personnel exiting a work area will follow decontamination procedures presented in the RPP (APTIM, 2017b). Decontamination areas will be located near work boundary exits.

The level of decontamination of equipment will be determined by the SSHO and PRSO. The need for and degree of decontamination will be based on the characteristics of the material within the work area and the potential for transporting contaminants outside of the work area.

7.5 Waste Management

A WMP was prepared to allow for proper storage, characterization, and disposal of liquid and solid waste generated during the field activities. Any investigation-derived waste will be managed in accordance with the WMP (Appendix C).

7.6 Demobilization

Demobilization will consist of surveying, decontaminating, and removing all equipment and materials, cleaning the project site, inspecting the site, and issuing a certification of completion. Demobilization activities will also involve collection and disposal of any contaminated materials, including decontamination water and disposable equipment for which decontamination is inappropriate.

8.0 Project Management Plan

The project management team will be responsible for all technical and administrative aspects of the site activities. Included among the team's responsibilities are the project schedule, staffing, data management, document control, project meetings, and reporting.

8.1 Key Project Personnel

Key personnel are provided in Table 6.

8.2 Document Control

APTIM's internal document control procedures will be followed for the duration of the project. Additional guidance provided by the Navy will be used for document control, particularly for matters relating to regulatory compliance. Management of internal and external correspondence will be administered at the home office in San Diego, California. Document control will include assigning alphanumeric codes to each submittal. Project files will be maintained in a secure, dry area at the field office.

8.3 Meetings and Reports

Project status/contractor QC meetings will be held weekly or biweekly (or at less frequent intervals if desired by the Navy) at the field office during the field construction activities. At a minimum, the ROICC and PQCM will attend this meeting. The Project Manager, Construction Manager, and other selected individuals will also attend these meetings with the CSO, ROICC, and RPM. All QC related documents and discussion are provided in the CQCP (Appendix B).

Daily reports will be prepared by the Construction Manager, PRSO, and the PQCM and submitted to the RPM, CSO, RASO, and ROICC. Weekly reports will be prepared by the Project Manager and submitted to the RPM. The weekly reports will include work completed by the end of each week and work that is planned for the following week.

8.4 Project Schedule

Figure 10 provides the current project schedule for Parcel F activities.

9.0 Reporting Requirements

Upon completion of radiological survey activities, two separate reports will be prepared to document the results of the Parcel F structures investigation; one report for the submarine pens, and a second report for the finger piers. If no contamination is found, the survey report will meet the requirements of a final status survey report with a recommendation for unrestricted radiological release. If contamination is found, then the survey report will define the extent of contamination and provide recommendations for remediation of the structures.

Each survey report will include the following items:

- Site conditions and background
- Description of field methods and procedures
- Any variances from the Work Plan during the survey with an approved field change request
- Field activities
- Survey results
- Data evaluation results including data conversion, summary statistics, graphical data review (e.g., histograms, normal probability plots), and comparison to background reference area data
- Conclusions and recommendations
- References
- Applicable appendices

The appendices will include survey data, waste information, sampling and survey information, and other supporting information as appropriate.

10.0 References

Aptim Federal Services, LLC (APTIM) 2017a, *Accident Prevention Plan, Radiological Work Tasks, Remedial Action and Maintenance of Remedies at Hunters Point Naval Shipyard, San Francisco, California*.

APTIM, 2017b, *Radiation Protection Plan, Radiological Work Tasks, Remedial Action and Maintenance of Remedies at Hunters Point Naval Shipyard, San Francisco, California*.

APTIM, 2017c, *APTIM Management System*.

ERS Joint Venture, 2012, *Final Removal Action Completion Summary Report, Pier Radiological Surveys and Removal, Hunters Point Naval Shipyard, San Francisco, California*.

Naval Facilities Engineering Command, 2017, *Unified Facilities Guide Specifications (UFGS)* "Section 01 45 00.00 20 Quality Control," Change 2, originally dated November 2011.

Naval Sea Systems Command, 2004, *Final Historical Radiological Assessment Volume II, History of the Use of General Radioactive Materials, 1939–2003, Hunters Point Shipyard, San Francisco, California*. August 31.

Radiological Affairs Support Office, 2013, *RASO Guidance Document, Conducting Alpha Scans for Radium*, December 17.

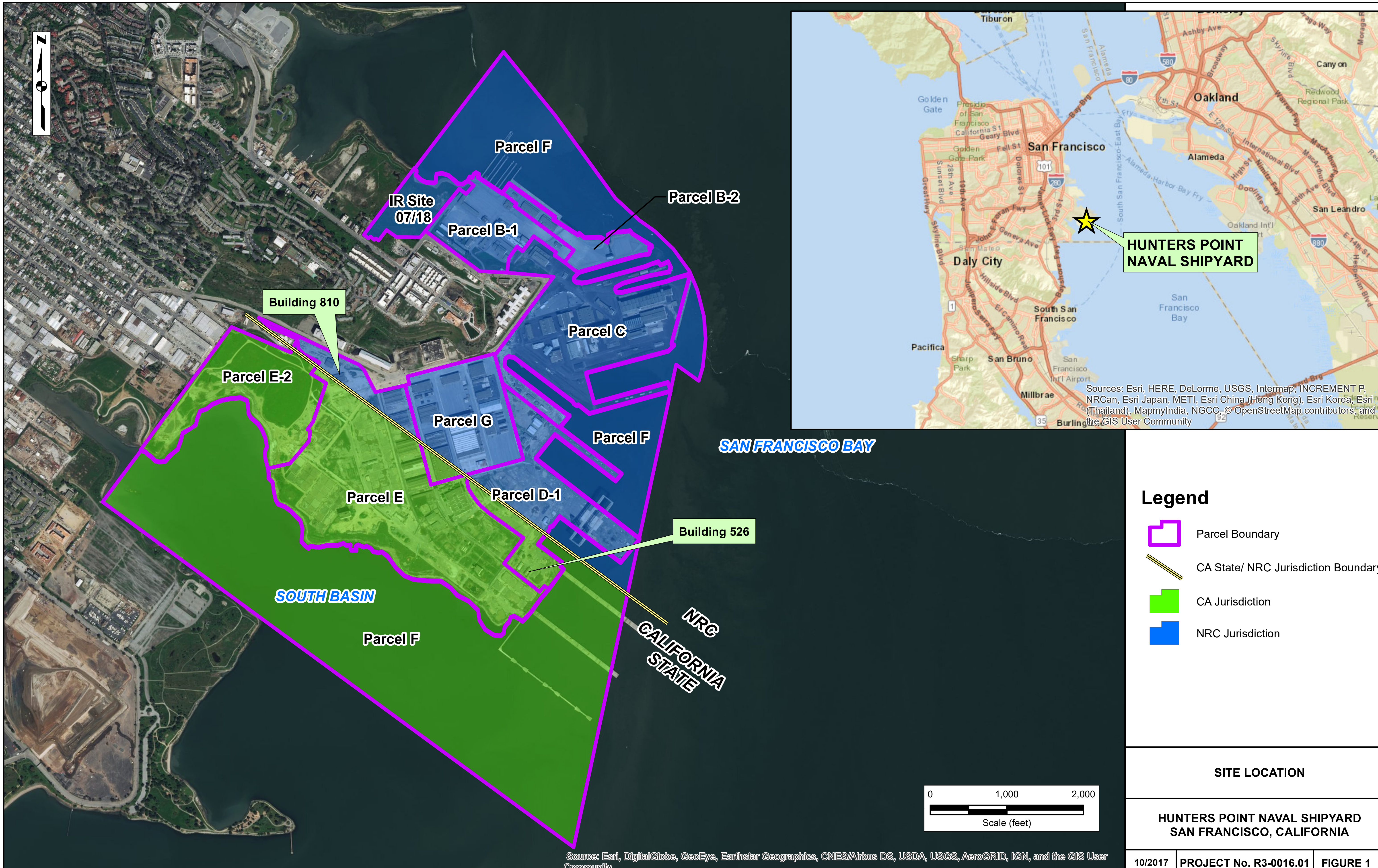
U.S. Army Corps of Engineers, 2014, *Safety and Health Requirements Manual EM 385-1-1*.

U.S. Department of the Navy, 2006, *Final Base-wide Radiological Removal Action, Action Memorandum—Revision 2006, Hunters Point Shipyard, San Francisco, California.*

U.S. Environmental Protection Agency, 2006, *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, Office of Environmental Information, EPA/240/B-06/001, Washington, D.C., February.

U.S. Nuclear Regulatory Commission, U.S. Environmental Protection Agency, and U.S. Department of Energy, 2000, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, NUREG-1575, EPA 402-R-97-016, DOE/EH-0624, Revision 1, Washington, D.C.

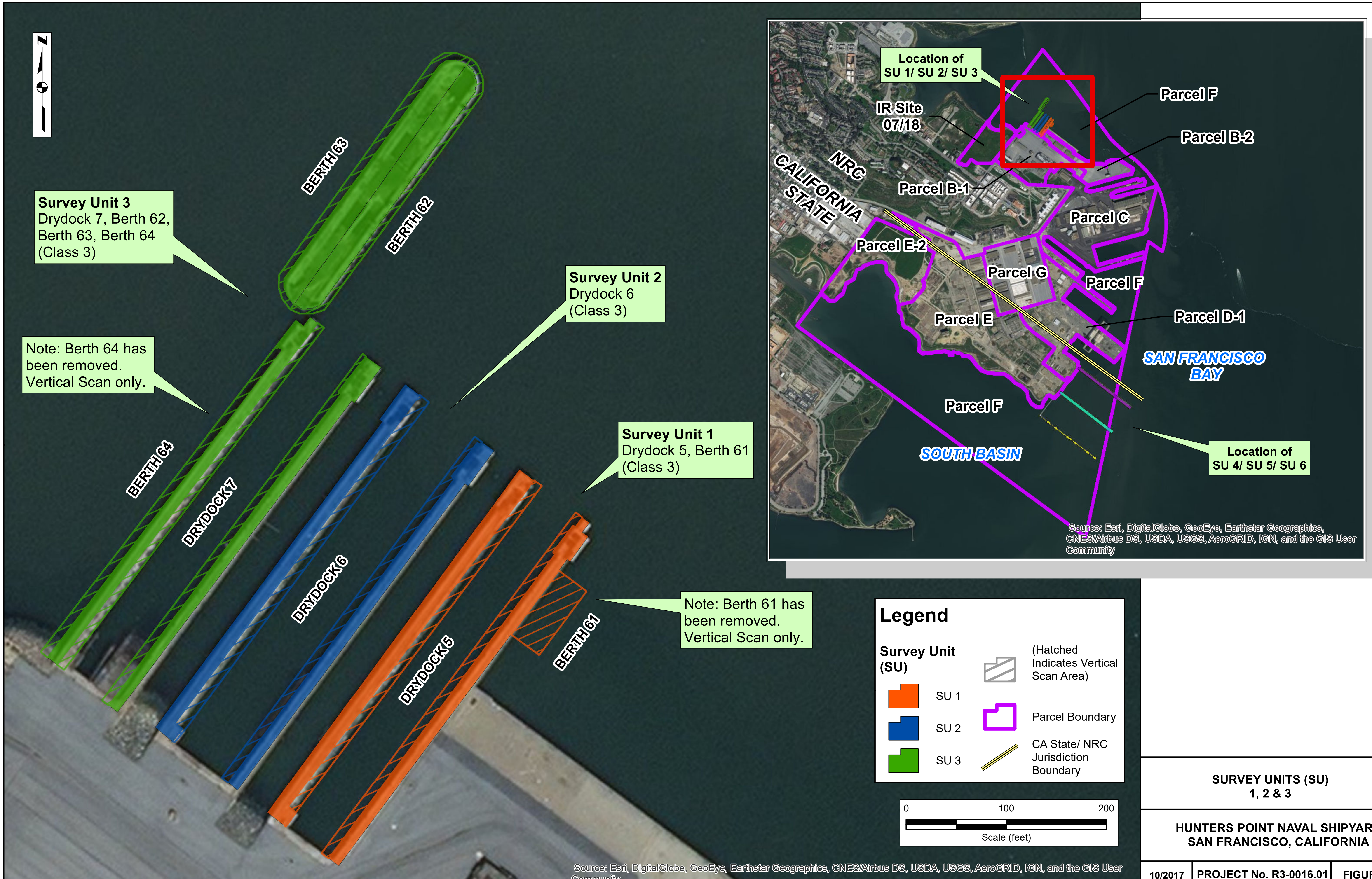
Figures



SITE LOCATION

HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

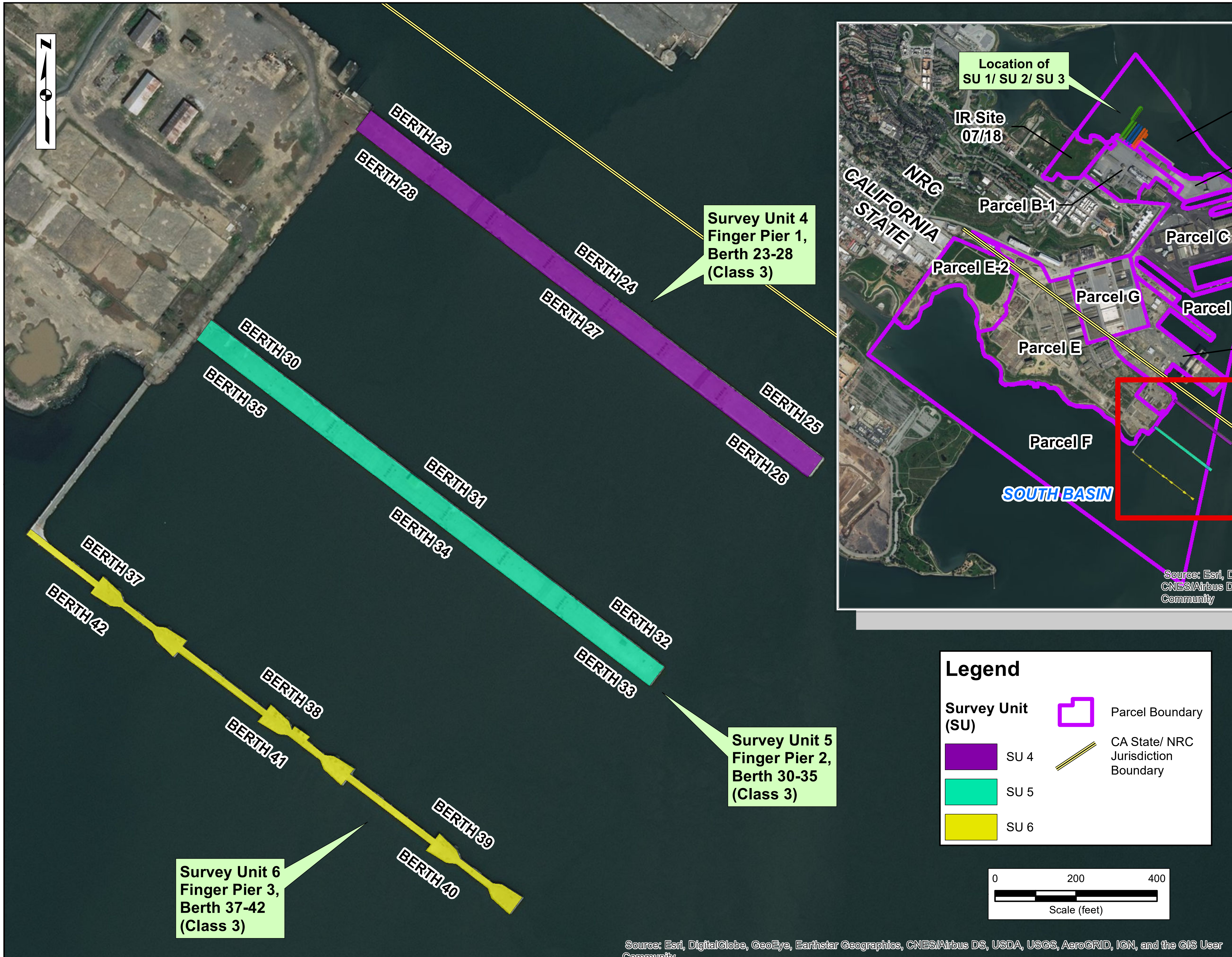
10/2017	PROJECT No. R3-0016.01	FIGURE 1



SURVEY UNITS (SU)
1, 2 & 3

HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

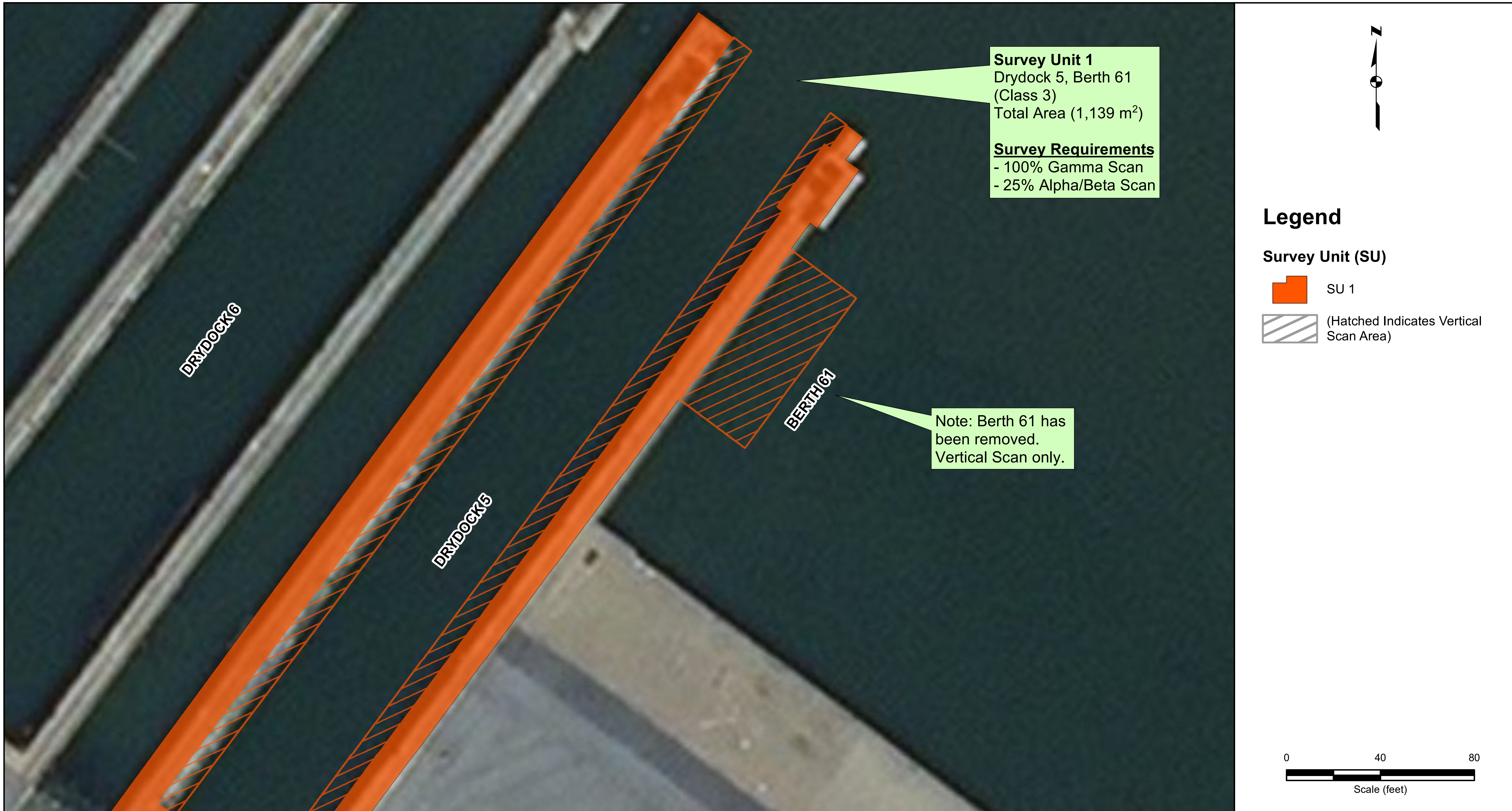
10/2017 | PROJECT No. R3-0016.01 | FIGURE 2



SURVEY UNITS (SU)
4, 5 & 6

HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

10/2017	PROJECT No. R3-0016.01	FIGURE 3



SURVEY UNIT (SU) 1

HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

10/2017	PROJECT No. R3-0016.01	FIGURE 4

SURVEY UNIT (SU) 2

HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

10/2017	PROJECT No. R3-0016.01	FIGURE 5

N

Legend

Survey Unit (SU)

SU 3

(Hatched Indicates Vertical Scan Area)

0 80 160

Scale (feet)

SURVEY UNIT (SU) 3

HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

10/2017	PROJECT No. R3-0016.01	FIGURE 6

SURVEY UNIT (SU) 4

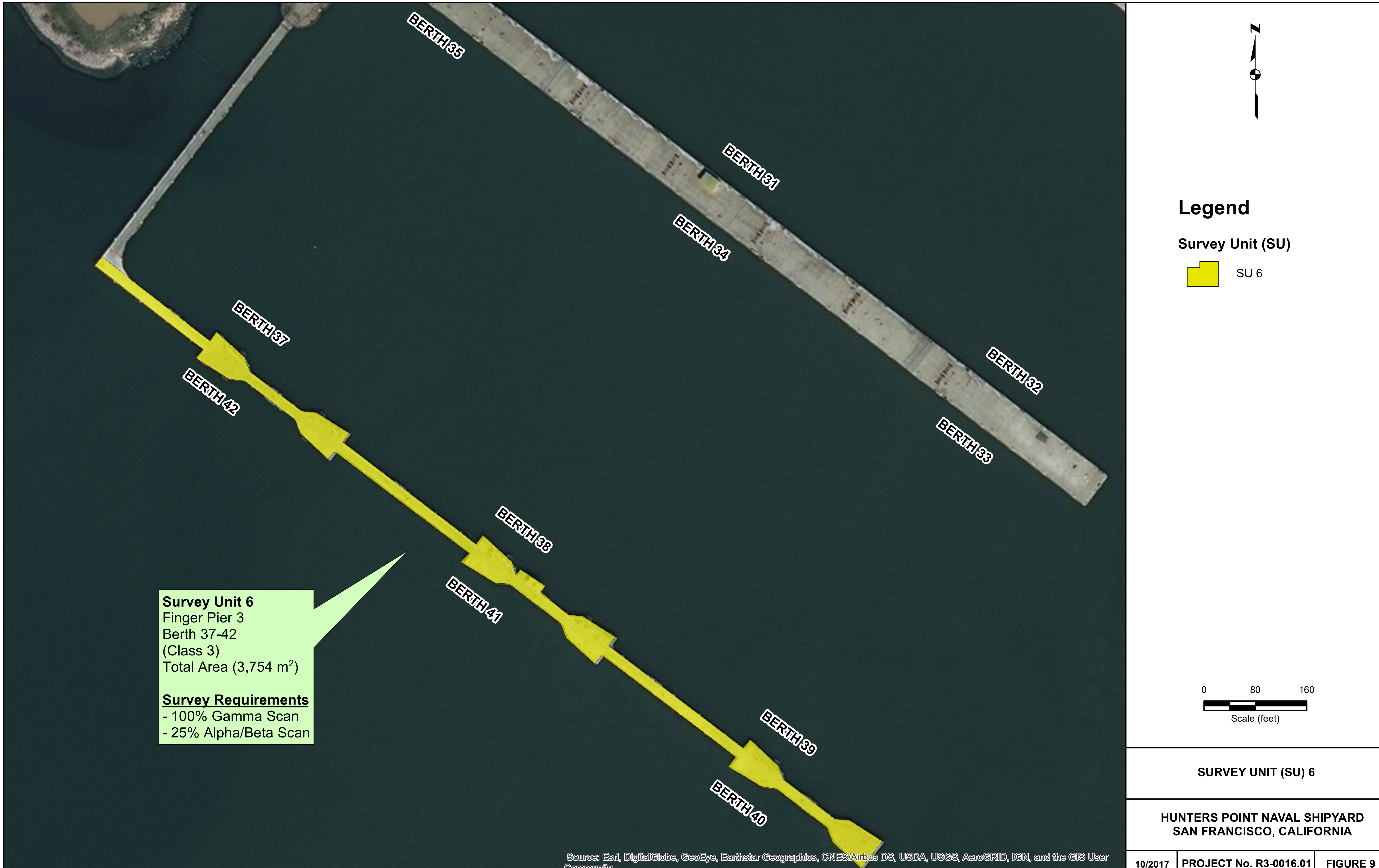
HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

10/2017	PROJECT No. R3-0016.01	FIGURE 7

SURVEY UNIT (SU) 5

HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

10/2017	PROJECT No. R3-0016.01	FIGURE 8

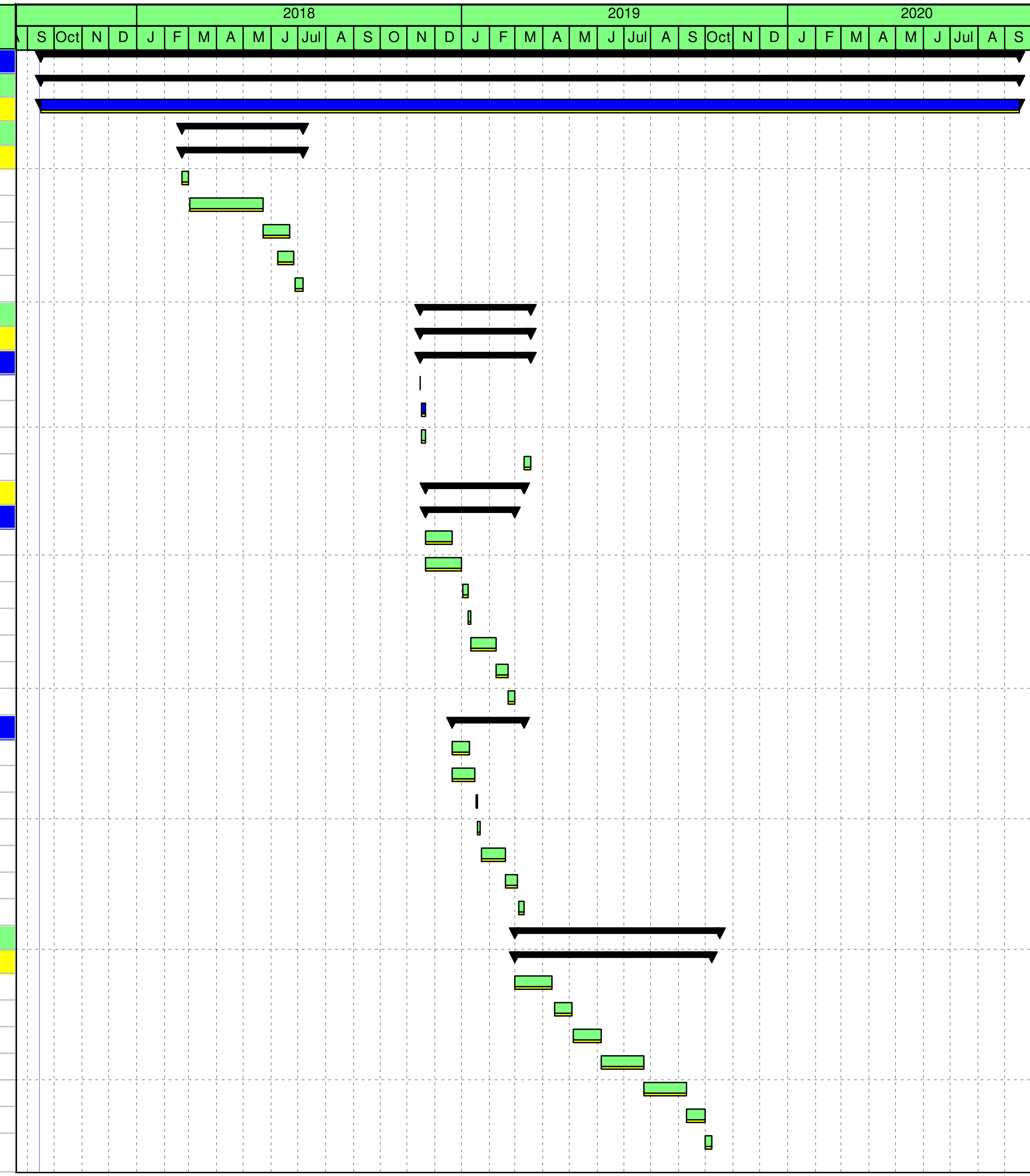


SURVEY UNIT (SU) 6

HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

10/2017	PROJECT No. R3-0016.01	FIGURE 9

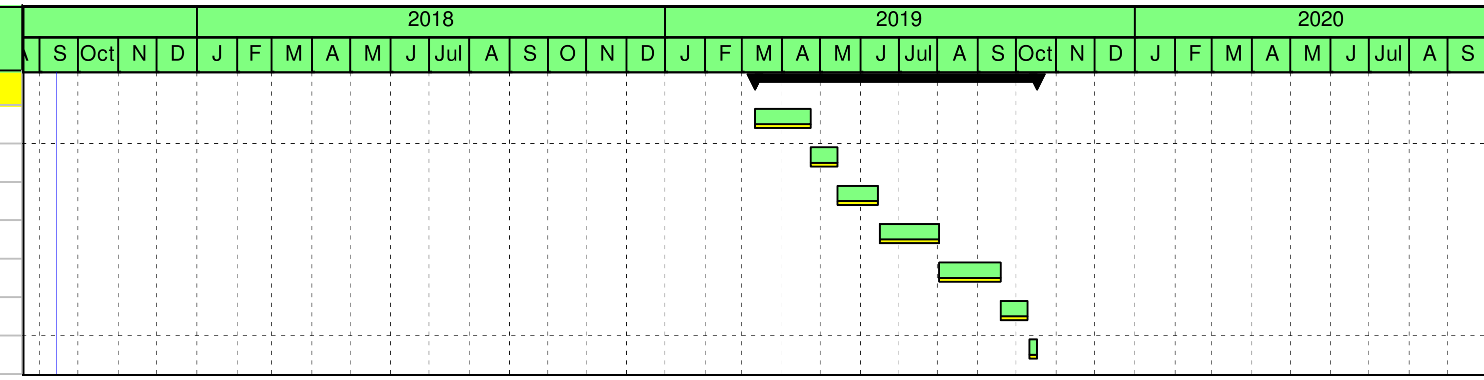
Activity Name	Original Duration	Start	Finish
DO 4550 Radiological Work Tasks at Parcels C, D-1, and F, Hunters Point Naval Shipyard	757	15-Sep-17	16-Sep-20
Work Element 1- Project Management Support	757	15-Sep-17	16-Sep-20
Project Mgmt - Project Management & Administrative Support	757	15-Sep-17	16-Sep-20
Work Element 3 - Planning Documents	95	21-Feb-18	06-Jul-18
Parcel F Structures (Piers and Submarine Pens)	95	21-Feb-18	06-Jul-18
Issue Draft Work Plan	6	21-Feb-18	28-Feb-18
Regulatory Review of Draft Work Plan (45 Calendar Day Review)	70	01-Mar-18	22-May-18
Prepare and Issue Response to Comments on the Draft Work Plan	21	23-May-18	21-Jun-18
Navy Review of Response to Comments on the Draft Work Plan (21 Calendar Days)	13	08-Jun-18	26-Jun-18
Issue Final Work Plan	7	27-Jun-18	06-Jul-18
Work Element 4 - Field Work Activities	83	15-Nov-18	18-Mar-19
Pre-Construction Activities	83	15-Nov-18	18-Mar-19
Mobilization/Demobilization	83	15-Nov-18	18-Mar-19
Pre-Construction Meeting	1	15-Nov-18	15-Nov-18
Mobilization	3	16-Nov-18	20-Nov-18
Permitting and Notifications	4	16-Nov-18	21-Nov-18
Parecl F Demobilization	5	12-Mar-19	18-Mar-19
Parcel F Structures (Piers and Subpens)	74	21-Nov-18	11-Mar-19
Radiological Surveys of Finger Piers	67	21-Nov-18	28-Feb-19
Characterization Survey	20	21-Nov-18	20-Dec-18
Data Review	25	21-Nov-18	31-Dec-18
Follow Up Statics/Biased Samples	4	02-Jan-19	07-Jan-19
Ship Biased Samples, Logged by Lab	3	08-Jan-19	10-Jan-19
Sample Analysis	20	11-Jan-19	07-Feb-19
Review Data and Prepare Data Package	10	08-Feb-19	21-Feb-19
RASO Review and Approval of Packages	5	22-Feb-19	28-Feb-19
Radiological Surveys of Submarine Pens	54	21-Dec-18	11-Mar-19
Gamma Walk Over Survey/Collect Systematic Samples	10	21-Dec-18	08-Jan-19
Data Review	15	21-Dec-18	15-Jan-19
Follow Up Statics/Biased Samples	2	16-Jan-19	17-Jan-19
Ship Biased Samples, Logged by Lab	2	18-Jan-19	21-Jan-19
Sample Analysis	20	22-Jan-19	18-Feb-19
Review Data and Prepare Data Package	10	19-Feb-19	04-Mar-19
RASO Review and Approval of Packages	5	05-Mar-19	11-Mar-19
Work Element 5 - Reports and Data Submittal	160	01-Mar-19	16-Oct-19
Parcel F Structures Characterization Survey Report-Finger Piers	153	01-Mar-19	07-Oct-19
Prepare Internal Draft Characterization Survey Report	30	01-Mar-19	12-Apr-19
Navy Review of Internal Draft Characterization Survey Report (21 Calendar Days)	15	15-Apr-19	03-May-19
Respond to Navy Comments and Issue Draft Characterization Survey Report	22	06-May-19	05-Jun-19
Regulatory Review of Draft Characterization Survey Report (45 Calendar Day Review)	33	06-Jun-19	23-Jul-19
Prepare and Issue Draft Final Characterization Survey Report	33	24-Jul-19	09-Sep-19
Navy Review of Draft Final Characterization Survey Report	15	10-Sep-19	30-Sep-19
Respond to Regulatory Comments and Issue Final Characterization Survey Report	5	01-Oct-19	07-Oct-19



Project Baseline Bar
Actual Work
Remaining Work
Critical Remaining Work
Milestone
Summary

Project Schedule - Delivery Order: N6247317F4550
Parcel F Piers and Submarine Pens,
Hunters Point Naval Shipyard, San Francisco, CA
Figure 10 - Project Schedule

Activity Name	Original Duration	Start	Finish
Parcel F Structures Characterization Survey Report-Submarine Pens	153	12-Mar-19	16-Oct-19
Prepare Internal Draft Characterization Survey Report	30	12-Mar-19	23-Apr-19
Navy Review of Internal Draft Characterization Survey Report (21 Calendar Days)	15	24-Apr-19	14-May-19
Respond to Navy Comments and Issue Draft Characterization Survey Report	22	15-May-19	14-Jun-19
Regulatory Review of Draft Characterization Survey Report (45 Calendar Day Review)	33	17-Jun-19	01-Aug-19
Prepare and Issue Draft Final Characterization Survey Report	33	02-Aug-19	18-Sep-19
Navy Review of Draft Final Characterization Survey Report	15	19-Sep-19	09-Oct-19
Respond to Regulatory Comments and Issue Final Characterization Survey Report	5	10-Oct-19	16-Oct-19



Project Baseline Bar
Summary
Actual Work
Remaining Work
Critical Remaining Work
Milestone

Project Schedule - Delivery Order: N6247317F4550
Parcel F Piers and Submarine Pens,
Hunters Point Naval Shipyard, San Francisco, CA
Figure 10 - Project Schedule

Tables

Table 1
Radionuclides of Concern and Release Criteria

ROC	Half-Life	Radiations	Static Activity for alpha and beta (dpm/100cm^2)	Removable Activity for alpha and beta (dpm/100cm^2)	Soil [1] (pCi/g)
Ra-226	1,600 years	Alpha (α) /gamma (γ)	100	20	1.0
Cs-137	30.17 years	Beta (β-) /gamma (γ)	5,000	1,000	0.113
Pu-239	2.41×10^4 years	Alpha (α) /gamma (γ)	100	20	2.59
Sr-90	28.6 years	Beta (β-)	1,000	200	0.331

Notes:

Release criteria are to be applied according to Multi-Agency Radiation Site Survey and Investigation Manual (MARSSIM) guidelines (NRC et al., 2000) as established in the Final Basewide Radiological Removal Action, Action Memorandum—Revision 2006, Hunters Point Shipyard, San Francisco, California (Navy, 2006).

[1] The project action limits are based on the U.S. Environmental Protection Agency preliminary remediation goals as cited in the Final Basewide Radiological Removal Action, Action Memorandum—Revision 2006, Hunters Point Shipyard, San Francisco, California (Navy, 2006) and are in addition to background values for these radionuclides.

Cs-137	*Cesium-137*
dpm/cm^2	*disintegration per minute/square centimeter*
Navy	*U.S. Department of the Navy*
NRC	*U.S. Nuclear Regulatory Commission*
pCi/g	*picocurie per gram*
Pu-239	*Plutonium-239*
Ra-226	*Raduim-226*
ROC	*radionuclide of concern*
Sr-90	*Strontium-90*

Table 2
Survey Unit Designations for Parcel F Structures

Site Location	Survey Units	Site Location Detail	MARSSIM Classification	Gamma Scanning	Alpha/Beta Scanning	Survey Description
Submarine Pens	SU 1	Drydock 5/ Berth 61	Class 3	100%	25%	Survey of horizontal and vertical surfaces of Drydock 5 and vertical surfaces of Berth 61 (Figure 4)
	SU 2	Drydock 6				Survey of horizontal and vertical surfaces of Drydock 6 (Figure 5)
	SU 3	Drydock 7/ Berths 62, 63, and 64				Survey of horizontal and vertical surfaces of Drydock 7, Berths 62, 63, and vertical surfaces of Berth 64 (Figure 6)
Finger Piers	SU 4	Finger Pier 1 Berths 23 through 28	Class 3	100%	25%	Survey of horizontal surfaces of Finger Pier 1 (Figure 7)
	SU 5	Finger Pier 2 Berths 30 through 35				Survey of horizontal surfaces of Finger Pier 2 (Figure 8)
	SU 6	Finger Pier 3 Berths 37 through 42				Survey of horizontal surfaces of Finger Pier 3 (Figure 9)

Notes

The Final Historical Radiological Assessment Volume II, History of the Use of General Radioactive Materials, 1939–2003, Hunters Point Shipyard, San Francisco, California (HRA; Naval Sea Systems Command, 2004), HRA Section 8.3.7.2 states the current potential for contaminated media as low or none. As defined in the HRA, a low potential categorization for media contamination indicates that the contamination potential is remote. The Parcel F Submarine Pens and Finger Piers Class 3 areas are consistent with MARSSIM classification (NRC et al., 2000) where there is little to no potential for a dose above the release criterion, or in this case, little to no potential for radionuclide concentrations exceeding the release criteria listed in Table 1 of the Work Plan (October 2018).

MARSSIM	*Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*
NRC	*U.S. Nuclear Regulatory Commission*
SU	*survey unit*

Table 3
Radiological Soil Measurements—Background Reference Area—Release Criteria

Sample	^{137}Cs			^{239}Pu			^{226}Ra			^{90}Sr		
	Result[a]	Flag	MDL	Result	Flag	MDL	Result	Flag	MDL	Result	Flag	MDL
03A- BKGD- 001	0.073		0.041				0.822	A	0.918			
03A- BKGD- 002	0.041		0.040				0.877	A	0.881			
03A- BKGD- 003	0.007	A	0.022				-0.044	#A	0.722			
03A- BKGD- 004	0.059		0.041				0.261	A	0.863			
03A- BKGD- 005	0.026	A	0.046				0.429	A	1.030			
03A- BKGD- 006	0.078		0.037	0.007	U	0.015	0.849	A	0.929	0.002	U	0.250
03A- BKGD- 007	0.017	A	0.037				0.676	A	0.892			
03A- BKGD- 008	-0.002	#A	0.033				0.482	A	0.711			
03A- BKGD- 009	0.006	A	0.018				0.433	A	0.679			
03A- BKGD- 010	0.096		0.029				0.701	A	0.930			
03A- BKGD- 011	0.007	A	0.030				1.371		0.867			
03A- BKGD- 012	0.001	A	0.024				0.526	A	0.849			
03A- BKGD- 013	0.025	A	0.033				0.600	A	0.757			
03A- BKGD- 014	0.013	#A	0.017				0.656	A	0.674			
03A- BKGD- 015	0.101		0.028				0.747		0.660			
03A- BKGD- 016	0.035		0.033				1.069		0.868			
03A- BKGD- 017	0.041		0.038				0.655	A	1.050			
03A- BKGD- 018	0.054		0.025				0.245	A	0.727			

Table 3 (continued)
Radiological Soil Measurements—Background Reference Area—Release Criteria

Sample	^{137}Cs			^{239}Pu			^{226}Ra			^{90}Sr		
	Result[a]	Flag	MDL	Result	Flag	MDL	Result	Flag	MDL	Result	Flag	MDL
03A- BKGD- 019	0.031		0.022	-0.008	U	0.019	0.750		0.687	0.050	U	0.240
03A- BKGD- 020	0.028	A	0.041				0.557	A	0.862			
Project Release Criterion	0.113			2.590			1.633			0.331		
Average	0.037			-0.001			0.633			0.026		
Standard Dev	0.031			0.011			0.306			0.034		
Maximum	0.101			0.007			1.371			0.050		
Minimum	-0.002			-0.008			-0.044			0.002		

Notes:

Release criteria are to be applied according to Multi-Agency Radiation Site Survey and Investigation Manual (MARSSIM) guidelines (NRC et al., 2000) as established in the Final Basewide Radiological Removal Action, Action Memorandum—Revision 2006, Hunters Point Shipyard, San Francisco, California (Department of the Navy, 2006).

[a] *Release criterion for radium-226 is 1 pCi/g above the average background (0.633 pCi/g), equal to 1.633 pCi/g.*

#	all peaks for activity calculation had bad shape
^{90}Sr	strontium-90
^{137}Cs	cesium-137
^{226}Ra	radium-226
^{239}Pu	plutonium-239
A	activity printed, but activity < MSA
MDL	minimum detection limit
NRC	U.S. Nuclear Regulatory Commission
pCi/g	picocurie per gram
U	result is less than the sample detection limit

Table 4
Field Survey Instrumentation

Measurement Type	Detector Type	Effective Detector Area and Window Density	Instrument Model	Detector Model
Dose Rate	NaI(Tl) scintillation	1-inch diameter x 1-inch length N/A	Ludlum 19 or Equivalent	N/A
Beta-Gamma	Geiger-Muller Survey Instrument	15 cm^2 0.3 mg/cm^2 mica	Ludlum 3 or Equivalent	Ludlum 44-9
Gamma	NaI(Tl) scintillation	3-inch x 3-inch length N/A	Ludlum 2221	Ludlum 44-20
Gamma	NaI(Tl) scintillation	4-inch x 4-inch x 16-inch length N/A	RS-700	RSX-1
Gamma	NaI Spectrometer (Nuclide Identification)	NA	Canberra Inspector 1000 or Equivalent	NA
Alpha/Beta Scan	Gas flow proportional	Floor Monitor Large Area (584 cm^2)	Ludlum 2360 or Equivalent	Ludlum 43-37
Alpha/Beta Static	Gas flow proportional	Large Area (584 cm^2)	Ludlum 2360 or Equivalent	Ludlum 43-37
Alpha/Beta Static	Gas flow proportional	Small Area (126 cm^2)	Ludlum 2360 or Equivalent	Ludlum 43-68
Alpha/Beta Swipes	Dual Phosphor scintillation	2-inch (5.1 cm) diameter 0.4 mg/cm^2	Ludlum 2929 or Equivalent	Ludlum 43-10-1

Notes:

cm	*centimeter*
cm^2	*square centimeter*
mg/cm^2	*milligram per square centimeter*
N/A	*Not Applicable*
NaI (TI)	*sodium iodide (thallium-doped)*

Table 5
Scan and Static Measurement Sensitivity Assumptions

Model No.	Nuclide type	Background count rate (cpm) [a]	Background count time (min)	Sample count time (min)	Total Efficiency[b]	Detector active area (cm^2)	MDC (dpm/100 cm^2)
Alpha and Beta Surface Scan - Sequential 6-second Static Counts (Section 5.5.5)							
43-37	alpha	3.3	10	0.1	0.06	582	86
43-37	beta	601	10	0.1	0.08	582	473
Alpha and Beta Static Counts (Section 5.5.6)							
43-37	alpha	3.3	10	2	0.06	582	21.5
43-37	beta	601	10	2	0.08	582	184
43-68	alpha	1.2	10	5	0.07	126	32
43-68	beta	273	10	5	0.12	126	202

Notes:

(a) Background count rate based on experience with similar detectors.

(b) Total efficiency equals instrument efficiency times surface efficiency, the efficiencies provided are typical values for similar detectors.

cm^2	*square centimeter*
cpm	*count per minute*
dpm/cm^2	*disintegration per minute/square centimeter*
MDC	*minimum detectable concentration*
min	*minute*

Table 6
Key Personnel

Agency	Contact	Project Title
NAVFAC SW 33000 Nixie Way, Building 50 San Diego, CA 92147	Leslie Howard 619.524.5903 leslie.howard.ctr@navy.mil	Navy Remedial Project Manager
NAVFAC SW 33000 Nixie Way, Building 50 San Diego, CA 92147	Sean-Ryan McCray 619.524.5322 seanryan.mccray@redhorsecorp.com	Navy Project Manager
Officer in Charge Naval Sea System Detachment Radiological Affairs Support Office ATTN: Matthew Liscio 160 Main Road Yorktown, Virginia 23691-5105	Matthew Liscio 757.887.4354 matthew.liscio@navy.mil	Navy Radiological Environmental Protection Manager
NAVFAC SW ROICC San Francisco Bay Area 950 W. Mall Square, Building 1, Suite 163 Alameda, CA 94501-7575	Shirley Ng 510.749.5939 (mobile) 510.521.8626 (office) shirley.ng@navy,mil	ROICC Project Engineer
NAVFAC SW CSO Hunters Point Naval Shipyard One Avenue of the Palms, Suite 161 San Francisco, CA 94130	Doug DeLong 415.743.4713 (office) 510.220.1894 (mobile) douglas.delong.ctr@navy.mil	CSO
U.S. Environmental Protection Agency, Region 9 75 Hawthorne Street (SFD-8-3) San Francisco, CA 94105	Lily Lee 415.947.4187 lee.lily@epa.gov	EPA RPM
California Department of Toxic Substances Control 700 Heinz Ave. Berkeley, CA 94710-2721	Nina Bacey 510.540.3480 juanita.bacey@dtsc.ca.gov	Cal/EPA DTSC RPM
California Department of Public Health Environmental Management Branch, MS 7402 1616 Capitol Ave Sacramento, CA 95899-7377	Sheetal Singh 916.449.5691 sheetal.singh@cdph.ca.gov	CDPH RPM
California Regional Water Quality Control Board, San Francisco Bay Region 1515 Clay Street, Suite 1400 Oakland, CA 94612	Tina Ures 510.622.2064 tina.ures@waterboards.ca.gov	RWQCB RPM
City and County of San Francisco Department of Public Health 1390 Market St., Suite 210 San Francisco, CA 94102	Amy Brownell 415.252.3967 amy.brownell@sfdph.org	San Francisco DPH RPM
Aptim Federal Services, LLC 1230 Columbia Street, Suite 600 San Diego, CA 92101	Lisa Bercik, PE 619.446.4508 (office) 619.213.3389 (mobile) lisa.bercik@aptim.com	Project Manager

Table 6 (continued)
Key Personnel

Agency	Contact	Project Title
Aptim Federal Services, LLC 4005 Port Chicago Hwy, Suite 200 Concord, CA 94520	Sean Orman 628.231.8025 (mobile) sean.orman@aptim.com	Construction Manager
Aptim Federal Services, LLC 1230 Columbia Street, Suite 600 San Diego, CA 92101	Steve Massey 619.987.6557 (mobile) stephen.massey@aptim.com	Program QC Manager
Aptim Federal Services, LLC 4005 Port Chicago Hwy, Suite 200 Concord, CA 94520	Lee Laws 925.759.1787 (mobile) lee.laws@aptim.com	PQCM
Aptim Federal Services, LLC 6380 South Fiddler's Green Circle Greenwood Village, CO 80111	Amy Mangel 303.486.2560 (office) 419.350.9429 (mobile) amy.mangel@aptim.com	Technical Lead
Aptim Federal Services, LLC 4038 Masonboro Loop Road Wilmington, NC 28409	Raymond Schul 518.496.5533 (mobile) raymond.schul@aptim.com	Radiological Operations Manager
Aptim Federal Services, LLC 200 Fischer Avenue Former Hunters Point Naval Shipyard San Francisco, CA 94124	Randall Killpack 415.6714.2969 (office) 801.244.2394 (mobile) rose.condit@aptim.com	Project Radiation Safety Officer/License Authorized User
Aptim Federal Services, LLC 4005 Port Chicago Hwy, Suite 200 Concord, CA 94520	Rose Condit 925.288.2151 (office) rose.condit@aptim.com	Program Chemist
Aptim Federal Services, LLC 4005 Port Chicago Hwy, Suite 200 Concord, CA 94520	Eddie Kalombo 925.288.2342 (office) eddie.kalombo@aptim.com	Project Chemist
Aptim Federal Services, LLC 4005 Port Chicago Hwy, Suite 200 Concord, CA 94520	Mark Egan 925.579.4073 (mobile) mark.egan@aptim.com	SSHO
Aptim Federal Services, LLC 16380 U.S. Route 224 East, Suite 100 Findlay, OH 45840	David Mummert 419.429.5509 (office) 419.348.1544 (mobile) david.mummert@aptim.com	CIH

Table 6 (continued)
Key Personnel

Notes:	
Cal/EPA	*California Environmental Protection Agency*
CDPH	*California Department of Public Health*
CIH	*Certified Industrial Hygienist*
CSO	*Caretaker Site Office*
DPH	*Department of Public Health*
DTSC	*California Department of Toxic Substances Control*
EPA	*U.S. Environmental Protection Agency*
NAVFAC SW	*Naval Facilities Engineering Command, Southwest*
PQCM	*Project Quality Control Manager*
QC	*quality control*
ROICC	*Resident Officer in Charge of Construction*
RPM	*Remedial Project Manager*
RWQCB	*California Regional Water Quality Control Board, San Francisco Bay Region*
SSHO	*Site Safety and Health Officer*

Appendix A
Sampling and Analysis Plan

SAP Worksheet #1: Title and Approval Page

Final Revision 1
SAMPLING AND ANALYSIS PLAN
(Field Sampling Plan and Quality Assurance Project Plan)

November 2018

Radiological Work Tasks, Remedial Action, and Maintenance of Remedies
Task: Radiological Characterization Surveys
Parcel F Structures, Hunters Point Naval Shipyard
San Francisco, California

Prepared for:

Base Realignment and Closure
Program Management Office West
Naval Facilities Engineering Command Southwest
33000 Nixie Way, Building 50
San Diego, California 92147

Prepared by:

Aptim Federal Services, LLC
4005 Port Chicago Highway, Suite 200
Concord, California 94520-1120
925.288.9898

Prepared under:

Contract Number: N62473-17-D-0006
Contract Task Order: N6247317F4550
Document Control Number: APTM-0006-4550-0025.R1/F

Review Signatures: Stephen P. Massey November 19, 2018
Stephen Massey/Program QA Manager Date

Approval Signatures: WALKER.TERESIE.R.1515870071 Digitally signed by WALKER.TERESIE.R.1515870071
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USN, cn=WALKER.TERESIE.R.1515870071
Date: 2018.11.20 16:22:23 -05'00'
Joe Arlauskas/NAVFAC SW QA Officer Date

EXECUTIVE SUMMARY

This Sampling and Analysis Plan (SAP) has been prepared by Aptim Federal Services, LLC (APTIM) to support radiological characterization surveys of the Parcel F structures (submarine pens and finger piers) located at Hunters Point Naval Shipyard, San Francisco, California (Figures 1, 2, and 3). Specifically, this SAP addresses tasks associated with large area gamma scans using the RS-700, gamma walkover surveys, and alpha/beta radiological scanning to support identification and removal of low-level radiological objects, and provide data that can be presented as a final status survey to achieve unrestricted release for Parcel F structures. The Parcel F structures to be sampled under this SAP include the submarine pens (Drydocks 5, 6, and 7; associated Ship Berths 61, 62, 63, and 64; Finger Piers 1, 2, and 3; and associated Ship Berths 23 through 28, 30 through 35, and 37 through 42.)

In general, off-site sample analysis is not anticipated for this project. However, if discrete sources or radiological objects are identified, sampling may be conducted for off-site analysis to better identify the source of activity and to assist in planning removal action if necessary. These activities will be performed in accordance with the Radiological Characterization Surveys Work Plan and *Radiation Protection Plan, Radiological Work Tasks, Remedial Action and Maintenance of Remedies at Hunters Point Naval Shipyard, San Francisco, California* (APTIM, 2017a); the State of California Radioactive Materials License No. 7889-07; and the U.S. Nuclear Regulatory Commission License 20-31340-01 issued to APTIM. No chemical sampling is anticipated for this portion of the work scope.

SAP Worksheets

SAP Worksheets (continued0

List of Figures

List of Attachments

List of Acronyms

%	percent
<	less than
>	greater than
±	plus or minus
≤	less than or equal to
≥	greater than or equal to
^{90}Sr	strontium-90
^{137}Cs	cesium-137
^{226}Ra	radium-226
^{239}Pu	plutonium-239
AM	*Final Basewide Radiological Removal Action, Action Memorandum - Revision 2006, Hunters Point Shipyard, San Francisco, California*
APTIM	Aptim Federal Services, LLC
BSC	background subtraction count
CCV	continuing calibration verification
CDPH	California Department of Public Health
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	chain-of-custody
DER	duplicate error ratio
DL	detection limit
DLC	decision level concentration
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DQA	data quality assessment
DQO	data quality objective
DTSC	California Department of Toxic Substances Control
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
FWHM	full width at half maximum
H&S	health and safety
HRA	*Final Historical Radiological Assessment, History and the Use of General Radioactive Materials, 1939-2003*
HPNS	Hunters Point Naval Shipyard
ICAL	initial calibration
ICV	initial calibration verification
ID	identification
IL	investigation level
keV	kiloelectron volt
LCS	laboratory control sample
LOD	limit of detection

List of Acronyms (continued)

MARLAP	*Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP)*
MARSSIM	*Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM)
MS	matrix spike
MSD	matrix spike duplicate
NAVFAC SW	Naval Facilities Engineering Command Southwest
NAVSEA	Naval Sea Systems Command
Navy	U.S. Department of the Navy
NRC	U.S. Nuclear Regulatory Commission
NRDL	Naval Radiological Defense Laboratory
OSHA	Occupational Safety and Health Administration
pCi/g	picocurie per gram
PM	project manager
POC	point of contact
QA	quality assurance
QAO	Quality Assurance Officer
QC	quality control
QSM	Quality Systems Manual for Environmental Laboratories, Version 5.0
RASO	Radiological Affairs Support Office
ROC	radionuclide of concern
RPD	relative percent difference
RPM	Remedial Project Manager
RPP	*Radiation Protection Plan, Radiological Work Tasks, Remedial Action and Maintenance of Remedies at Hunters Point Naval Shipyard, San Francisco, California*
RSO	Radiation Safety Officer
SAP	sampling and analysis plan
SOP	standard operating procedure
SSHO	Site Safety and Health Officer
UFP-QAPP	*Uniform Federal Policy for Quality Assurance Project Plans, Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs*
Water Board	California Regional Water Quality Control Board

SAP Worksheet #2: SAP Identifying Information

Site Name/Number:	**Radiological Characterization Surveys, Parcel F Structures, Hunters Point Naval Shipyard (HPNS)**
Contractor Name:	**Aptim Federal Services, LLC (APTIM)**
Contract Number:	**N62473-17-D-0006**
Contract Title:	**RADMAC II**
Work Assignment Number (optional):	**Contract Task Order N6247317F4550**

1. This Sampling and Analysis Plan (SAP) was prepared in accordance with the *Uniform Federal Policy for Quality Assurance Project Plans, Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs* (UFP-QAPP; U.S. Environmental Protection Agency [EPA], 2005) and *EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5, Office of Environmental Information* (EPA, 2001). With additional guidance from the following publications:

   - *Quality Systems Manual for Environmental Laboratories, Version 5.1* (QSM; U.S. Department of Defense [DoD], 2017)
   - *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006)
   - *Environmental Work Instruction 3EN2.1—Chemical Data Validation* (Naval Facilities Engineering Command Southwest [NAVFAC SW], 2001)
   - *Environmental Work Instruction EVR.2—Review, Approval, Revision, and Amendment of Sampling and Analysis Plans* (NAVFAC SW, 2011)
   - *Environmental Work Instruction EVR.4—Implementing and Maintaining the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Administrative Record and Compendium at NAVFAC Southwest* (NAVFAC SW, 2007)
   - *Environmental Work Instruction EVR.6—Environmental Data Management and Required Electronic Delivery Standards* (NAVFAC SW, 2005)

2. Identify regulatory program: Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).

3. This is a project-specific SAP.

4. List dates of scoping sessions that were held: September 25, 2017 (Project Kick-Off Meeting)

SAP Worksheet #2: SAP Identifying Information (continued)

5. List dates and titles of any SAP documents written for previous site work that are relevant to the current investigation.

Title	Date
No relevant documents available	

6. List organizational partners (stakeholders) and connection with lead organization:

Oversight by the California Department of Toxic Substances Control (DTSC)
Oversight by the California Department of Public Health (CDPH), Division of Drinking Water and Environmental Management
Oversight by the California Regional Water Quality Control Board (Water Board)
Oversight by the EPA

7. Lead organization

U.S. Department of the Navy (Navy)

8. If any required SAP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion below:

No worksheets omitted

SAP Worksheet #2: SAP Identifying Information (continued)

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
A. Project Management		
Documentation		
1	Title and Approval Page	
2	Table of Contents; SAP Identifying Information	
3	Distribution List	
4	Project Personnel Sign-Off Sheet	
Project Organization		
5	Project Organizational Chart	
6	Communication Pathways	
7	Personnel Responsibilities and Qualifications Table	
8	Special Personnel Training Requirements Table	
Project Planning/Problem Definition		
9	Project Planning Session Documentation (Including Data Needs Tables); Project Scoping Session Participants Sheet	
10	Problem Definition, Site History, and Background Site Maps (Historical and Present)	
11	Site-Specific Project Quality Objectives	
12	Measurement Performance Criteria Table	
13	Sources of Secondary Data and Information Secondary Data Criteria and Limitations Table	
14	Summary of Project Tasks	
15	Reference Limits and Evaluation Table	
16	Project Schedule/Timeline Table	
B. Measurement Data Acquisition		
Sampling Tasks		
17	Sampling Design and Rationale	
18	Sampling Locations and Methods/Standard Operating Procedure (SOP) Requirements Table Sample Location Map(s)	
19	Analytical Methods/SOP Requirements Table	
20	Field Quality Control (QC) Sample Summary Table	
21	Project Sampling SOP References Table Sampling SOPs	
22	Field Equipment Calibration, Maintenance, Testing, and Inspection Table	

SAP Worksheet #2: SAP Identifying Information (continued)

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
Analytical Tasks		
23	Analytical SOPs Analytical SOP References Table	
24	Analytical Instrument Calibration Table	
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	
Sample Collection		
26	Sample Handling System, Documentation Collection, Tracking, Archiving and Disposal Sample Handling Flow Diagram	
27	Sample Custody Requirements, Procedures/SOPs Sample Container Identification Example Chain of Custody (COC) Form and Seal	
QC Samples		
28	QC Samples Table Screening/Confirmatory Analysis Decision Tree	
Data Management Tasks		
29	Project Documents and Records Table	
30	Analytical Services Table Analytical and Data Management SOPs	
C. Assessment Oversight		
31	Planned Project Assessments Table Audit Checklists	
32	Assessment Findings and Corrective Action Responses Table	
33	Quality Assurance (QA) Management Reports Table	
D. Data Review		
34	Verification (Step I) Process Table	
35	Validation (Steps IIa and IIb) Process Table	
36	Validation (Steps IIa and IIb) Summary Table	
37	Usability Assessment	

Notes:

UFP-QAPP (EPA, 2005)

SAP Worksheet #3: Distribution List

Name of SAP Recipients	Title/Role	Organization	Telephone Number	Email Address or Mailing Address
Leslie Howard	Remedial Project Manager (RPM)	NAVFAC SW	619.524.5903 (office)	leslie.howard.ctr@navy.mil Base Realignment and Closure Program Management Office West 33000 Nixie Way, Bldg. 50 San Diego, California 92147
Sean-Ryan McCray	Navy Project Manager	NAVFAC SW	619.524.5322 (office)	sean-ryan.mccray@redhorsecorp.com Base Realignment and Closure Program Management Office West 33000 Nixie Way, Bldg. 50 San Diego, California 92147
Matthew Liscio	Navy Radiological Environmental Protection Manager	Radiological Affairs Support Office (RASO); Naval Sea System Command Detachment	757.887.4354 (office)	matthew.liscio@navy.mil Officer in Charge Naval Sea System Detachment Radiological Affairs Support Office ATTN: Matthew Liscio 160 Main Road Yorktown, Virginia 23691-5105
Joe Arlauskas	Quality Assurance Officer (QAO)	NAVFAC SW	619.532.4125 (office)	joseph.arlauskas@navy.mil 1220 Pacific Highway San Diego, California, 92132
Sheetal Singh	CDPH RPM	CDPH	916.449.5691	sheetal.singh@cdph.ca.gov California Department of Public Health Environmental Management Branch 1616 Capitol Avenue, MS 7402 Sacramento, California 95814
Amy Brownell	San Francisco Department of Public Health RPM	San Francisco Department of Public Health	415.252.3967	amy.brownell@sfdph.org City and County of San Francisco Department of Public Health 1390 Market St., Suite 210 San Francisco, California 94102

SAP Worksheet #3: Distribution List (continued)

Name of SAP Recipients	Title/Role	Organization	Telephone Number	Email Address or Mailing Address
Nina Bacey	DTSC RPM	DTSC	510.540.2480	juanita.bacey@dtsc.ca.gov California Department of Toxic Substances Control 700 Heinz Ave., Bldg. F, Suite 200 Berkeley, California 94710
Tina Ures	Water Board RPM	Water Board	510.622.2064	tina.ures@waterboards.ca.gov SF Bay Regional Water Quality Control Board, 1515 Clay Street, Suite 1400 Oakland, California 94612
Lily Lee	EPA RPM	EPA, Region 9	415.947.4187	lee.lily@epa.gov U.S. Environmental Protection Agency, Region 9 75 Hawthorne Street (SFD-8-3) San Francisco, California 94105
Ulrika Messer	Program Manager	APTIM	619.446.4529 (office)	ulrika.messer@aptim.com 1230 Columbia Street, Suite 600 San Diego, California 92101
Lisa Bercik	Project Manager (PM)	APTIM	619.446.4508 (office)	lisa.bercik@aptim.com 1230 Columbia Street, Suite 600 San Diego, California 92101
Rose Condit	Program Chemist	APTIM	925.288.2151 (office)	rose.condit@aptim.com 4005 Port Chicago Highway, Suite 200 Concord, California 94520
Eddie Kalombo	Project Chemist	APTIM	415.987.0760 (mobile)	eddie.kalombo@aptim.com 4005 Port Chicago Highway, Suite 200 Concord, California 94520
Steve Massey	Program QC Manager	APTIM	619.446.4522 (office)	stephen.massey@aptim.com 1230 Columbia Street, Suite 600 San Diego, California 92101

SAP Worksheet #3: Distribution List (continued)

Name of SAP Recipients	Title/Role	Organization	Telephone Number	Email Address or Mailing Address
Raymond Schul	Radiological Operations Manager	APTIM	518.496.5533 (mobile)	raymond.schul@aptim.com 4038 Masonboro Loop Road Wilmington, North Carolina 28409
Randall Killpack	Project Radiation Safety Officer (RSO)/License Authorized User	APTIM	801.244.2394 (mobile)	randall.killpack@atpim.com 200 Fischer Avenue Former Hunters Point Naval Shipyard San Francisco, California 94124
Minh Chi	Project RSO Representative	APTIM	415.741.8299 (mobile)	minhsec.chi@aptim.com 200 Fischer Avenue Former Hunters Point Naval Shipyard San Francisco, California 94124
Jim Langsted	Certified Health Physicist	APTIM	303.486.2513 (office)	amy.meldrum@aptim.com 6380 South Fiddler's Green Circle Greenwood Village, Colorado 80111
Amy Mangel	Technical Lead	APTIM	303.486.2560 (office)	amy.mangel@aptim.com 6380 South Fiddler's Green Circle Greenwood Village, Colorado 80111
Lee Laws	Project QC Manager	APTIM	925.759.1787 (mobile)	lee.laws@aptim.com 950 Avenue M, Building 570 San Francisco, California 94130
Mark Vennemeyer	Alternate QC Manager	APTIM	925.383.6502 (mobile)	mark.vennemeyer@aptim.com 4005 Port Chicago Highway, Suite 200 Concord, California 94520

SAP Worksheet #3: Distribution List (continued)

Name of SAP Recipients	Title/Role	Organization	Telephone Number	Email Address or Mailing Address
Bachir Badaoui	Site Radiation Safety Lead	Cabrera Services Inc.	916.897.1756 (mobile)	bbadaoui@cabreraservices.com 50 Founders Plaza, Suite 207 East Hartford, Connecticut 06108
Rhonda Ridenhower	Laboratory PM	Test America, St. Louis Laboratory	314.298.8566	Rhonda.Ridenhower@testamericainc.com 13715 Rider Trail North Earth City, Missouri 63045
Larry Duty	Data Validation PM (copy of final SAP only)	E-Lab Consultants, LLC	832.364.0173	lduty@e-labdc.com

SAP Worksheet #4: Project Personnel Sign-Off Sheet

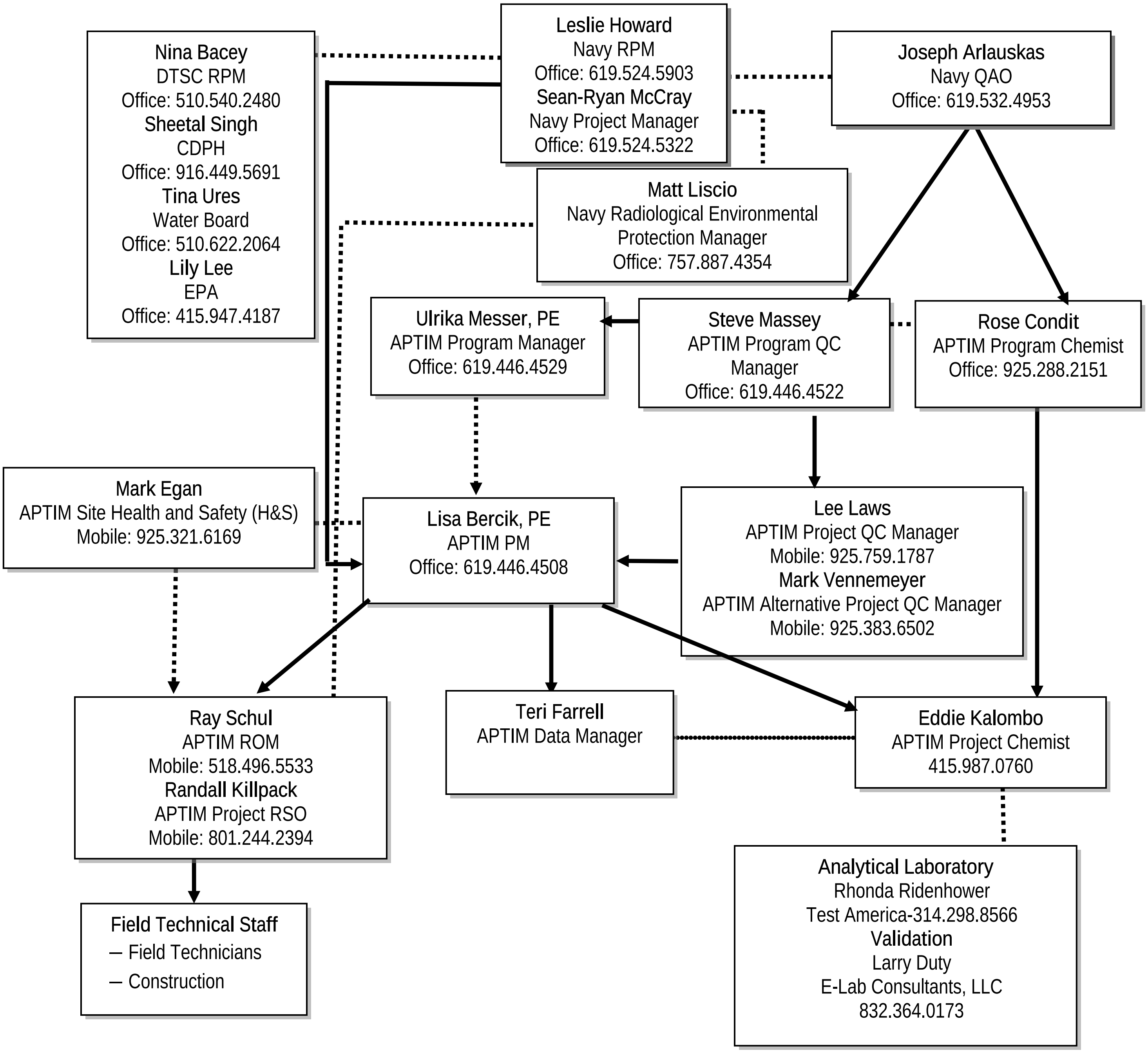
Name	Organization/Title/Role	Signature/Email Receipt	SAP Section Reviewed	Date SAP Read
Lisa Bercik	APTIM PM			
Eddie Kalombo	APTIM Project Chemist			
Lee Laws	APTIM Project QC Manager			
Barbara Matz	APTIM Alternate Project QC Manager			
Rhonda Ridenhower	Test America PM			
Larry Duty	E-Lab Consultants, LLC data validation project manager			

Note:

The signed SAP Worksheet #4 will be stored in the on-site project files, and then will be transferred to the APTIM Concord, California home office file storage at completion of fieldwork.

SAP Worksheet #5: Project Organization Chart

Lines of responsibility (solid lines) and lines of communication (dotted lines) are provided.



SAP Worksheet #6: Communication Pathways

Communication Drivers	Responsible Affiliation	Name	Telephone Number	Procedure
Communication with regulators	Navy RPM Navy Project Manager	Leslie Howard Sean-Ryan McCray	619.524.5903 619.524.5322	Any significant corrective actions or changes to approved plans will be communicated to regulators by the Navy RPM within 72 hours via email and during regular field work updates, such (Base Realignment and Closure Cleanup Team meetings).
Point of Contact (POC) with the Navy RPM and RASO	PM Asst. PM	Lisa Bercik Jamie Egan	619.446.4508 415.636.4036	Materials and information about the project will be forwarded to the RPM by the PM or Asst. PM with 72 hours or as soon as practical.
SAP Changes in the Field	Project Chemist or Program Chemist	Rose Condit Eddie Kalombo	925.288.2151 415.987.0760	The Project Chemist is responsible for documenting field changes related to sampling. The Project Chemist or Program Chemist is also responsible for generating SAP amendments as necessary for approval by the Navy QAO. The Project Chemist oversees the documentation, notification, and corrective actions associated with project management issues in writing. Due to the potential impact field changes and SAP amendments may have on the project, the Project Chemist is to be notified of such issues within 24 hours.
Sampling Quality Issues	Project or Program QC Manager Project or Program Chemist	Lee Laws, Mark Vennemeyer, or, Steve Massey Eddie Kalombo or Rose Condit	925.759.1787 925.383.6502 619.446.4522 415.987.0760 925.288.2151	In general, the Project Chemist is the POC for sampling and chemistry issues and the Project QC Manager is the POC for other quality issues. If quality issues are not resolved at the project level (in consultation with the PM, Project Site Superintendent, Technical Lead, etc.), then the issue will be elevated to the Program Chemist or Program QC Manager). The Program Chemist or designee will seek additional guidance or approval from the Navy QAO, if necessary. Upon resolution, the Project QC Manager or Project Chemist oversees the documentation, notification, and corrective actions associated with the QA issues in writing within five business days.

SAP Worksheet #6: Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Telephone Number	Procedure
Sample Collection Issues	Project Chemist or Program Chemist	Eddie Kalombo or Rose Condit	415.987.0760 925.288.2151	The Project Chemist is the POC for sampling and chemistry issues. If sampling issues are not resolved at the project level (in consultation with the PM and other staff), then the issue will be elevated to the Program Chemist (Rose Condit) or Program QC Manager. The Program Chemist or Program QC Manager will seek additional guidance or approval from the Navy QAO, if necessary. Upon resolution, the Project Chemist oversees the documentation, notification, and corrective actions associated with the QA issues in writing. Due to the potential impact, sampling issues may have on the project the Project Chemist is to be notified of sampling issues within 24 hours.
Laboratory Reporting or Data Quality Issues	Program Chemist/ Data Manager	Rose Condit	925.288.2151	The Project Chemist is the POC for laboratory issues. The project Data Manager is the POC for electronic data deliverables (EDD). If laboratory issues are not resolved with the Project Chemist or Data Manager, then the issue will be elevated to the Program Chemist. If significant problems are identified from the laboratory that will impact the usability of the data, the Project Chemist should inform the PM, Navy RPM, and other parties as applicable within 24 hours of discovery or by the next business day. Upon resolution, the Project Chemist oversees the documentation, notification, and corrective actions associated with the laboratory issue in writing.
Stop Work Issues (Quality)	Navy QAO	Joe Arlauskas	619.532.4125	The Navy QAO is authorized to suspend project execution if QA requirements are not adequately followed. The Navy QAO will notify the Navy RPM and APTIM Program QC Manager if QC issues requiring stop work are identified. The APTIM Program QC Manager or Program Chemist, in consultation with the Task Order Manager and Navy RPM, will work with the Navy QAO to resolve QA issues and resume work. Upon resolution, the Project QC Manager oversees the documentation, notification, and corrective actions associated with site issues in writing within five business days.

SAP Worksheet #6: Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Telephone Number	Procedure
Notification of Non-Usable Analytical Data	Program Chemist	Rose Condit	925.288.2151	If significant problems are identified by the laboratory or the project team that impact the usability of the data (i.e., the data is rejected or the data quality objectives are not met), the Program Chemist will notify the NAVFAC SW RPM and the NAVFAC SW QAO within 24 hours or the next business day.
Field Activity Issues	PM Assistant PM	Lisa Bercik Jamie Egan	619.446.4508 415.260.9803	The PM is the POC for project site activities such as scheduling, staffing, subcontractors, fieldwork, etc. The Assistant PM, in consultation with the PM and Navy RPM, if necessary, will resolve project site issues. Upon resolution, the PM or Assistant PM oversees the documentation, notification, and corrective actions associated with site issues in writing. The PM or Assistant PM is to be notified of site issues within 24 hours.
H&S Issues	Site Safety and Health Officer (SSHO)	Mark Egan or Mark Vennemeyer	925.321.6169 925.383.6502	The Project SSHO is the POC for H&S issues. If H&S issues are not resolved at the project level (in consultation with the PM, Project Site Superintendent, Technical Lead, etc.), then the issue will be elevated to the Program SSHO. The Program SSHO or designee will seek additional guidance or approval from the Navy SSHO, if necessary. Upon resolution, the Project SSHO oversees the documentation, notification, and corrective actions associated with the issue in writing. Due to the potential seriousness of H&S issues, the SSHO is to be notified of H&S issues immediately.
Stop Work Issues (H&S)	SSHO APTIM Employees	Mark Egan or Mark Vennemeyer	925.321.6169 925.383.6502	Employees have the right and duty to stop work when conditions are unsafe, or when established safety procedures are being disregarded. Whenever an employee determines that workplace conditions present an immediate uncontrolled risk of injury or illness, immediate resolution with the appropriate supervisor shall be sought. Should the supervisor be unable or unwilling to correct the unsafe conditions, the employee is authorized and required to issue a Stop Work Order in accordance with APTIM Procedure AMS-710-05-PR-00400, “Stop Work Authority” (2017b). The specific activity or operation in question shall be discontinued until the issue is resolved.

SAP Worksheet #7: Personnel Responsibilities and Qualifications Table

Name	Title/Role	Organizational Affiliation	Responsibility
Leslie Howard Sean-Ryan McCray	Navy RPM Navy Project Manager	Navy	Manages governmental oversight of the project. Manages project funding and scope. Coordinates project documents review. Primary contact and liaison with regulatory agencies. Responsible for technical oversight of the project.
Matt Liscio	Navy Radiological Environmental Protection Manager	RASO	As deemed necessary by RASO/Base Realignment and Closure: Reviewing radiological laboratory data. Performing on-site reviews of all radiological site operations Reviewing final reports. Reviewing data for proposed radiological actions.
Lisa Bercik or Jamie Egan	PM Assistant PM	APTIM	Manages oversight of the project for APTIM. POC for communication with the Navy RPM and Navy contracts. Ensures that requirements of project contract are attained in a manner consistent with project plans. Oversees planning, execution, and conclusion of project activities. Manages project budgets and schedules. Develops work plans to address project scope of work. Prepares work plan variances, if necessary. Manages technical project elements.
Rose Condit	Program Chemist	APTIM	Reviews and approves this SAP; Guides the selection of subcontract analytical laboratories. Serves as a POC for the Navy QAO. Develops corrective action as required; Serves as a technical advisor to the project.

SAP Worksheet #7: Personnel Responsibilities and Qualifications Table (continued)

Name	Title/Role	Organizational Affiliation	Responsibility
Eddie Kalombo	Project Chemist	APTIM	Develops the project data quality objectives (DQO) and prepares this SAP. Selects qualified subcontract laboratories. Implements data QC procedures and audits field performance. Reviews laboratory data prior to use. Oversees third-party validation of laboratory data, if required. Reviews data validation report. Prepares the appropriate sections of the report summarizing the project sampling activities.
Randall Killpack	Project RSO	APTIM	Oversees overall radiological operations and documentation for the project. Acts as the Technical Lead for radiological data collection. Ensures that the Project Radiological Control Technicians have adequate training in sample collection. Receives and reviews QA laboratory sample data to ensure DQOs are met.
Lee Laws Mark Vennemeyer	Project QC Manager Alternate Project QC Manager	APTIM	Develops the project QC objectives and prepares the QC Plan. Administers the QC Plan. Manages QC documentation and QC deliverables. Lists definable features of work. Conducts inspections (preparatory, initial, follow-up, completions).
Mark Egan Mark Vennemeyer	SSHO Alternate SSHO	APTIM	Develops and administers the Site Safety and Health Plan. Manages personnel and environmental monitoring. Coordinates preparation of job safety analyses. Selects appropriate personal protective equipment and facilitates daily safety meetings. Reviews essential H&S requirements with on-site personnel.
APTIM Field Technician	Field Technician (sampling)	APTIM	Performs sampling in accordance with approved SAP. Ensures that field QC samples are collected as specified in the SAP. Completes field documentation and implements field corrective actions as required. Must have Occupational Safety and Health Administration (OSHA) 40-hour Certification and 8-hour OSHA Refresher Certification as appropriate.

SAP Worksheet #7: Personnel Responsibilities and Qualifications Table (continued)

Name	Title/Role	Organizational Affiliation	Responsibility
Rhonda Ridenhower	Laboratory PM	Test America	Oversees proper analysis and reporting of project samples according to approved SAP. Manages communication between laboratory and APTIM Project Chemist. Ensures proper QA/QC procedures are followed during laboratory analysis.
Larry Duty	Data Validation PM	E-Lab Consultants, LLC	Performing data validation according to applicable methods and approved SAP Reviewing laboratory reports for compliance with applicable methods and approved SAP Applying validation qualifiers to analytical data Preparing data validation report

SAP Worksheet #8: Special Personnel Training Requirements Table

Field personnel will be required to have completed the OSHA 40-hour Hazardous Waste Operations and Emergency Response Standard Protection training, continued 8-hour Hazardous Waste Operations and Emergency Response, and submit to annual medical surveillance, as required by OSHA. The APTIM SSHO will be responsible for ensuring that training and/or certification is met and that qualified personnel are performing the work.

Project Function	Specialized Training—Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records and Certificates
On-Site Project Personnel	Title 49 Transportation Subpart H Function-specific Training	Radiological Controls Supervisor	Prior to start of fieldwork	On-Site Project Personnel	Radiological Controls Supervisor	APTIM Project Files
	Radiation Worker Training (see *Radiation Protection Plan, Radiological Work Tasks, Remedial Action and Maintenance of Remedies at Hunters Point Naval Shipyard, San Francisco, California* [RPP]; APTIM, 2017a)	APTIM Project RSO or designee	Prior to start of fieldwork	On-Site Project Personnel	APTIM SSHO	APTIM Project Files
Radiological Monitoring Personnel	Site-Specific Qualification	Radiological Controls Supervisor	Prior to start of fieldwork	Junior and Senior Radiological Controls Technicians	Radiological Controls Supervisor	APTIM Project Files

SAP Worksheet #9: Project Scoping Session Participants Sheet

Project Name: Radiological Work Tasks, Remedial Action and Maintenance of Remedies Task: Basewide Radiological Support at Hunters Point Naval Shipyard	
Projected Date(s) of Sampling: 2017–2020	
PM: Lisa Bercik	Site Location: Hunters Point Naval Shipyard, San Francisco CA
Date of Session: September 25, 2017	
Scoping Session Purpose: Project kick-off meeting	

Name	Title	Affiliation	Phone #	Email Address	Project Role
Leslie Howard	RPM	Navy	619.524.5903	leslie.howard.ctr@navy.mil	RPM
Danielle Janda	Lead RPM	Navy	619.524.6041	danielle.janda@navy.mil	Lead RPM
Veronica Gonzales	RPM	Navy	619.524.5755	veronica.gonzales@navy.mil	RPM
Doug Delong	Caretaker Site Office	Navy	415.743.4713	douglas.delong.ctr@navy.mil	Caretaker Site Office
Shirley Ng	Resident Officer in Charge of Construction	Navy	510.521.8713	shirley.ng@navy.mil	Resident Officer in Charge of Construction
Lisa Bercik	PM	APTIM	619.446.4508	lisa.bercik@aptim.com	PM
Jim Click	Construction Manager	APTIM	303.345.8998	james.click@aptim.com	Construction Manager
Mike Ayala	Site Lead	APTIM	925.408.7121	mike.ayala@aptim.com	Site Lead
Mark Egan	SSHO	APTIM	925.579.4073	mark.egan@aptim.com	SSHO
Randall Killpack	Project RSO	APTIM	415.671.2969	randall.killpack@aptim.com	Project RSO
Barbara Matz	Alternate SSHO/Alternate Project QC Manager	APTIM	415.713.8482	barbara.matz@aptim.com	SSHO
Ray Schul	Program RSO	APTIM	518.496.5533	raymond.schul@aptim.com	Program RSO
Jim Langsted	Certified Health Physicist	APTIM	303.486.2513	jim.langsted@aptim.com	Certified Health Physicist
Jamie Egan	PM	APTIM	415.260.9803	jamie.egan@aptim.com	Assistant PM
Mark Vennemeyer	Project QC Manager	APTIM	925.579.4073	mark.vennemeyer@aptim.com	Project QC Manager

Comments/Decisions:	Project kick-off meeting for all Radiological Work Task at Hunters Point Naval Shipyard Items discussed included radiological project objectives, logistics, site access, RASO oversight and project schedule
Action Items/ Decisions:	None

SAP Worksheet #10: Problem Definition

Based on the *Final Historical Radiological Assessment, History and the Use of General Radioactive Materials, 1939-2003* (HRA; Naval Sea Systems Command [NAVSEA], 2004), Parcel F structures including the submarine pens and finger piers are radiologically impacted (Figure 1). The objective of this work effort is to identify residual radioactivity or low-level radiological objects (e.g., deck markers) attached to surfaces of the submarine pens and finger piers. As a conservative measure, 100 percent gamma and 25 percent alpha/beta scanning will be performed for all accessible surface areas. If no residual radioactivity exceeding the project release criteria is found, the radiological surveys will be presented as a final status survey to achieve unrestricted release to the sites.

10.1 SITE HISTORY AND DESCRIPTION

The HRA (NAVSEA, 2004) provides information on the historical use of radioactive materials at HPNS. As determined in the HRA, the radionuclides of concern (ROCs) for the Parcel F structures are cesium-137 (^{137}Cs), plutonium-239 (^{239}Pu), radium-226 (^{226}Ra), and strontium-90 (^{90}Sr).

10.2 SITE DESCRIPTION AND HISTORY

Drydocks 5, 6, and 7 and associated Ship Berths 61, 62, 63, and 64 (Figure 2) were built in 1944 for submarine repair, but were also capable of housing destroyers and other relatively small vessels. The drydocks are each approximately 420 feet by 60 feet, with a gate that is hinged at the bottom that flaps down to allow the vessel to enter. Each drydock was dewatered by four 20,000-gallon-per-minute pumps. Two pumps were located at each side of the San Francisco Bay end of the dock (NAVSEA, 2004). The following radiological operations were performed at Drydocks 5, 6, and 7 and associated Ship Berths 61, 62, 63, and 64:

- Decontamination of Operation Crossroads ships in Drydock 6, potential decontamination of Operation Crossroads ships in Drydock 5 and Drydock 7
- Ship repair (submarines)
- Naval Nuclear Propulsion Program operations in Drydock 6

The following radiological operations were performed at Finger Piers 1, 2, and 3 and associated Ship Berths 23 through 28, 30 through 35, and 37 through 42 (Figure 3):

- Berthing of Operation Crossroads ships
- Berthing of YGN-73 radioactive waste disposal barge

- Berthing of Naval Radiological Defense Laboratory (NRDL) experimental barges and YAG-39 and YAG-40 (ships used to support and study the effects of nuclear and atomic weapons tests)

Radiological operations generally performed at HPNS that could impact the submarine pens and finger piers included the use of generally licensed radioactive material, including handling and refurbishment of radioluminescent devices. Other activities involving radioactive material included gamma radiography, and calibration of radiation detection instruments.

In 2012, the Navy performed a removal action that included Ship Berths 61 and 64 in the submarine pens. The objective of the removal action was to remove radiologically impacted overwater structures that were dilapidated, dropping debris into the San Francisco Bay, and the debris that presented hazards to navigation in the San Francisco Bay (ERS Joint Venture, 2012). Radioactive material was not encountered during the course of the removal action, and no radioactive waste was generated.

10.3 NATURE AND EXTENT OF CONTAMINATION

A history of Navy radiological operations at HPNS is provided in the HRA (NAVSEA, 2004). Radioluminescent devices were used on ships and in shipyards to provide markers that could be seen under low-light conditions. These radioluminescent devices included ^{226}Ra or ^{90}Sr as a source of radioactivity to generate light using these devices. The HRA describes the potential for contamination of Parcel F ships' berths as likely, meaning the sites were impacted by past historical radiological activities performed by the Navy. There is a low probability that intact radioluminescent devices could still be present at the submarine pens and the finger piers. However, it is more likely traces of radioactivity from damaged, discarded, or lost devices could be present on surfaces associated with the Parcel F structures, although the probability of residual radioactivity from radioluminescent devices is still low. Although the potential for contamination is conservatively classified as "likely" (due to historical activities), HRA Section 8.3.7.2 states the current potential for contaminated media including soil, groundwater, structures, drainage systems and surrounding air as low or none.

Drydocks and ship berths were decontaminated and surveyed following maintenance and decontamination of radiologically impacted ships. Sandblast material was removed and disposed of as described in Section 6.4.1 of the HRA (NAVSEA, 2004). After removal of the sand, the drydock floor was vigorously washed and the water pumped into the harbor. The drydocks were surveyed, and met the criteria for release. ROCs from nuclear and atomic weapons tests would include a mixture of fission products, activations products, and actinides. ^{137}Cs and ^{239}Pu were selected as ROCs most likely to be present and most likely to be detected as contamination at HPNS. Radioactivity from contaminated ships is most likely to occur where contaminated ship surfaces could come into contact with drydocks or piers. Surveys of the drydocks following decontamination operations failed to identify areas of elevated radioactivity, so the probability of residual radioactivity from contaminated ships at the submarine pens or finger piers is low.

Radioactive wastes from NRDL and ship decontamination activities were loaded on barges at HPNS and transported for disposal in the ocean. Radioactive wastes included sandblasting residue from ship decontamination activities, as well as waste from NRDL laboratories and experiments (NAVSEA, 2004). Expected radiological waste constituents include a mixture of fission products, activation products, and actinides. ^{137}Cs and ^{239}Pu were selected as representative ROCs. Radioactive wastes were typically sealed in drums or other packages for transport, and may have been staged on piers or alongside ship berths prior to loading the waste onto the barges. The potential for residual radioactivity at the submarine pens and piers from leaking waste packages is low. The most likely location for residual radioactivity would be horizontal surfaces adjacent to ship berths where the waste packages could be staged prior to loading on the YGN-73 barge for disposal.

SAP Worksheet #11: Project Quality Objectives/Systematic Planning Process Statements

Step 1 Define the Problem that Necessitates the Study

Based on the HRA (NAVSEA, 2004), Parcel F structures including the submarine pens and finger piers are radiologically impacted. The objective of this work effort is to identify residual radioactivity and low-level radiological objects (e.g., deck markers) attached to surfaces at the submarine pens and finger piers. As a conservative measure, 100 percent gamma and 25 percent alpha/beta scanning will be performed for all accessible surface areas. If no residual radioactivity exceeding the project release criteria is found, the radiological surveys will be presented as a final status survey to achieve unrestricted release of the sites.

Step 2 Identify the Goal of the Study

The study question is as follows:

- Are levels of residual radioactivity present at the Parcel F structures that would prevent unrestricted release?

The following alternative actions will result from the resolution of the principle study question:

- If residual radioactivity is found during the radiological surveys at levels that would prevent unrestricted release of the site, then the Navy will be notified of the presence of residual radioactivity to determine the appropriate next steps for further investigation and the areas will be re-surveyed as Class 1 areas.
- If residual radioactivity is not found at levels that would prevent unrestricted release of the site during the radiological surveys, then no further investigation will be performed and the area will be recommended for unrestricted use.

Step 3 Identify Information Inputs

The following data will be used to satisfy the goal of the study:

Radiological surveys will include the following:

- Surface gamma scanning surveys for 100 percent for accessible surfaces of the submarine pens and finger piers
- Surface alpha/beta scanning surveys for 25 percent for accessible surfaces of the submarine pens and finger piers
- Static measurements of alpha/beta activity at a statistically determined number of random locations to estimate the average level of residual radioactivity
- Static measurements of alpha/beta or gamma activity at biased locations to investigate scanning survey results exceeding project investigation levels (ILs) (if any)
- Measurements of removable alpha/beta activity will be collected at locations based on the highest static measurements of alpha/beta activity

No off-site laboratory analysis is planned for this project. However, samples may be collected to investigate discrete sources of elevated radioactivity, if required. If collected, samples will be analyzed primarily by gamma spectroscopy (EPA Method 901.1 or equivalent) for ^{137}Cs, ^{226}Ra and daughters, and other gamma emitting radionuclides. Other radionuclide-specific analyses will be performed as noted in subsequent worksheets.

Step 4 Define the Boundaries of the Study

The spatial boundaries for this study are the Parcel F submarine pens (Figure 2) and the Parcel F finger piers (Figure 3). The vertical boundary of the project area extends from the top of the drydock, berth, or pier to the low tide line. The horizontal boundary is defined by the concrete surfaces forming the submarine pens and finger piers.

SAP Worksheet #11: Project Quality Objectives/Systematic Planning Process Statements (continued)

Step 5	*Develop the Analytic Approach*

If the mean results of the survey are below or consistent with the release criteria (WS#15), the data will be used to support free release of the structures.

If the mean results of the survey exceed the screening criteria, the site will be further investigated as described in the decision rules.

- The IL for gamma scan measurements is the average of gamma scan measurements for a specific material in a specific survey unit plus three standard deviations. If a gamma scan survey result exceeds the IL, that location will be incorporated into the surface area covered by the alpha/beta scanning survey. The IL for gamma scan measurements will be determined separately using the RS-700 and gamma scintillator hand-held radiation detection instruments.
- The IL for alpha/beta static measurements is 50 percent of the most conservative (i.e., lowest) release criteria provided in Table 1 in the *Final Base-wide Radiological Removal Action, Action Memorandum - Revision 2006, Hunters Point Shipyard, San Francisco, California* (AM; Navy, 2006) for alpha and beta emitting radionuclides. If an alpha or beta static count result exceeds the corresponding IL, the static count will be repeated to confirm the result. If the confirmatory result exceeds the corresponding IL, the APTIM PM and project radiation safety officer will be notified that an area of elevated alpha or beta activity has been identified.
- The IL for removable alpha or beta activity is the most conservative (i.e., lowest) release criteria provided in Table 1 in the AM (Navy, 2006) for alpha and beta emitting radionuclides. If a removable measurement result for alpha or beta exceeds the IL, a notification will be sent to the APTIM project radiation safety officer.

Step 6	*Specify Performance or Acceptance Criteria*

To limit uncertainty in the obtained environmental data, criteria for the precision, accuracy, representativeness, completeness, and comparability parameters and limit of detection (LOD) for the contaminants of concern have been developed. Measurement errors will be controlled by using appropriate sampling and analytical methods, and the laboratory errors will be controlled by adhering to the DoD QSM (2017), following established SOPs, and having the Project Chemist performing data review to verify laboratory processes. The field crews will review the SAP before sample collection to limit sample collection errors. The subcontract analytical laboratory will have a copy of this SAP and will adhere to DoD QSM (2017) guidance to limit measurement errors.

The *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* (MARSSIM; U.S. Nuclear Regulatory Commission [NRC] et al., 2000) guidelines will be used and a 95 percent confidence level for detecting radioactivity above the release criterion will be assumed with Type I and II errors limited to 5 percent.

Step 7	*Plan the Design for Obtaining Data*

The radiological survey design for this project is based on MARSSIM guidelines (NRC et al., 2000). Specific details regarding types of radiation measurements, instrument detection capabilities, quantities and locations of data to be collected and ILs are discussed in the Radiological Characterization Surveys Work Plan.

SAP Worksheet #12: Measurement Performance Criteria Table—Field Quality Control Samples (Soil)

QC Sample	Analytical Group	Frequency	Data Quality Indicators	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Matrix Spikes (MS)	Not applicable				
Rinse Blanks	Not applicable				
Field Duplicates	None	Not applicable to structural materials and concrete	Not Applicable	Not Applicable	S&A

SAP Worksheet #13: Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title and Date)	Data Generator(s) (Originating Organization, Data Types, Data Generation/Collection Dates)	How Data Will Be Used	Limitations on Data Use
Existing site radiological data	*Final Historical Radiological Assessment, History and the Use of General Radioactive Materials, 1939-2003, Hunters Point Shipyard*	NAVSEA, 2004	Site characterization	None

SAP Worksheet #14: Summary of Project Tasks

14.1 SCOPE OF WORK

The scope of the planned remediation activities consists of the following elements:

- Conduct gamma survey of 100 percent of accessible surface areas of the submarine pens (Drydocks 5, 6, and 7 and associated Ship Berths 61, 62, 63, and 64) and three Finger Piers.
- Conduct gamma survey of 100 percent of accessible areas that are inaccessible to the RS-700 detectors using a 3-inch by 3-inch sodium iodide gamma scintillator hand-held radiation detection instrument.
- Perform alpha/beta survey of 25 percent of accessible surface areas of the submarine pens and finger piers consistent with MARSSIM guidance (NRC et al., 2000) or Class 3 surveys.
- Identify areas or locations of elevated radioactivity (e.g., deck markers that are readily distinguished from ambient background radioactivity).
- Discrete sources, if identified during the scanning, will be removed and documented. Additional surveys and sampling will be performed to document the removal of radioactivity associated with discrete radiation sources.
- Perform measurements of static and removable alpha/beta activity at a statistically determined number of random locations for each survey unit to estimate the average activity consistent with MARRSIM guidance (NRC et al., 2000) for Class 3 surveys.
- Perform measurements of static and removable alpha/beta activity at biased locations where the gamma and alpha/beta scan results exceed the IL.

14.2 SAMPLE COLLECTION METHODS AND PROCEDURES

The following subsections describe the sampling methods and procedures that will be used to collect samples for this project.

14.2.1 Solid Samples

If directed by the Navy, solid samples of concrete or similar materials may be collected to provide specific information concerning the nature and extent for areas of elevated residual radioactivity exceeding the release criteria. Sample collection methods will be determined based on the material being sampled and the location of the sample.

Structural material sampling may be conducted to supplement radiological surveys. Material samples for off-site radiological analysis will be collected using techniques most suitable to the material being sampled and analyses to be performed. Concrete or wood may be sampled using chips as discussed in this section.

If concrete or wood debris requires sampling, chips of material for analysis will be obtained using hammers and chisels or other means to obtain near surface debris chips. Material samples for off-site radiological analysis will be collected using the general sampling technique described as follows:

1. Obtain decontaminated sampling (chisels, hammers, or other applicable equipment).
2. Put on a new (unused) pair of sampling gloves and other appropriate personal protective equipment.
3. Using chisels, saws, or hammers, reduce the material to small-size pieces for laboratory analysis. Collect the material pieces for radiological analysis into the appropriate sample containers.
4. Label, package, and prepare the samples for shipment to the laboratory.
5. Radiologically release sample containers from the radiological areas prior to shipment to the laboratory.

14.2.2 Equipment Decontamination

Sampling equipment decontamination is not anticipated for this project since disposable equipment will be used to collect samples if necessary.

14.3 ANALYTICAL REQUIREMENTS

Analytical methods will be performed according to the applicable EPA and DoD QSM (2017) QC requirements (e.g., initial calibrations [ICALs], continuing calibrations, tuning, reagent blanks, surrogates, replicates, and laboratory control sample [LCS]) as described in Worksheets #24 and #28.

14.4 QUALITY CONTROL TASKS

Samples will have appropriate associated QC samples, analyzed as method blanks and LCS, as described in Worksheet #28.

14.5 DATA RECORDING AND TRANSFER

This subsection details the requirements for data reporting and data package formats that will be provided by the laboratory.

14.5.1 Hard Copy Deliverables

Relevant raw data and documentation, including (but not limited to) logbooks, data sheets, electronic files, and final reports, will be maintained by the laboratory for at least 10 years. The laboratory will notify APTIM 30 days before disposal of any relevant laboratory records.

The laboratory will provide data deliverable packages sufficient to perform validation at 90 percent Stage 2B (EPA Level 3 deliverable equivalent) and 10 percent Stage 3 (EPA Level 4 deliverable equivalent).

14.5.2 Electronic Deliverables

The laboratory EDD will be in Equis format (APTIM database format). The analytical laboratory will follow the requirements stated in the Laboratory Interface Document for the Analytical Laboratory EDD.

The laboratory will certify that the EDD and the hard copy reports are identical. Both the EDD and the hard copy will present results to two or three significant figures. Field information (e.g., date and time collected and sample identification) will be entered directly into the main database from the COC record or uploaded from electronic files generated in the field.

14.6 DATA MANAGEMENT

This subsection describes the data management procedures for data review, verification, reporting, and validation.

14.6.1 Data Reduction, Verification, and Reporting

Analytical data generated by the laboratory will be reviewed prior to reporting to ensure the validity of reported data. This internal laboratory data review process will consist of data reduction, three levels of documented review, and reporting. Review processes will be documented using appropriate checklist forms, or logbooks that will be signed and dated by the reviewer.

14.6.2 Data Reduction

Data reduction involves the mathematical or statistical calculations used by the laboratory to convert raw data to the reported data. The laboratory will perform reduction of analytical data as specified in each of the appropriate analytical methods and laboratory SOPs. For each method, raw data results will be recorded using method-specific forms or a standardized output from each of the various instruments.

Data calculations will be verified and initialed by personnel both generating and approving them. Raw and electronic data, notebook references, supporting documentation, and correspondence will be assembled, packaged, and stored for a minimum of 10 years for future use. Reports will be held client confidential. If the laboratory is unable to store project-related data for 10 years, then it is the responsibility of the laboratory to contact APTIM to make alternative arrangements.

14.6.3 Laboratory Data Verification and Review

The laboratory analyst who generates the analytical data will have the primary responsibility for the correctness and completeness of data. Each step of this verification and review process will involve the evaluation of data quality based on both the results of the QC data and the professional judgment of those conducting the review. This application of technical knowledge and experience to the evaluation of data is essential in ensuring that data of known quality are generated consistently. Data generated and reduced will follow well-documented in-house protocols.

Level 1. Laboratory Technical (Peer) Data Review

Analysts will review the quality of their work based on an established set of guidelines, including the QC criteria established in each method, in this SAP, and as stated within the laboratory DoD QSM (2017). This review, at a minimum, will ensure that the following conditions have been met:

- Sample preparation information is correct and complete.
- Analysis information is correct and complete.
- Appropriate SOPs have been followed.
- Calculations are verified.
- There are no data transposition errors.
- Analytical results are correct and complete.
- QC samples are within established control limits.
- Blanks and LCS are within appropriate QC limits.
- Special sample preparation and analytical requirements have been met.

Documentation is complete, for example, when any anomalies and holding times have been documented, and forms have been completed.

Level 2. Laboratory Technical Data Review

A supervisor or data review specialist whose function is to provide an independent review of data packages will perform this review. This review will also be conducted according to an established set of guidelines and will be structured to verify the following findings of the Level 1 data review:

- Appropriate laboratory SOPs have been followed.
- Calibration data are scientifically sound, appropriate to the method, and completely documented.
- QC samples are within established guidelines.
- Qualitative identification of contaminants is correct.

- Manual integrations are justified and properly documented.
- Quantitative results and calculations are correct.
- Data are qualified correctly.
- Documentation is complete; for example, any anomalies and holding times have been documented, and appropriate forms have been completed.
- Data are ready for incorporation into the final report.
- The data package is complete and complies with contract requirements.

The Level 2 review will be structured so that calibration data and QC sample results are reviewed, and the analytical results from at least 10 percent of the samples are checked back to the sample preparation and analytical bench sheets. If no problems are found with the data package, the review will be considered complete.

If any problems are found with the data package, an additional 10 percent of the sample results will be checked back to the sample preparatory and analytical bench sheets. This cycle will then be repeated either until no errors are found in the checked data set, or until data have been checked. Errors and corrections noted will be documented.

Level 3. Laboratory Administrative Quality Assurance Data Review

The laboratory QA Manager will review 10 percent of data packages. This review should be similar to the review as provided in Level 2, except that it will provide a total overview of the data package to ensure its consistency and compliance with project requirements. Errors noted will be corrected and documented.

14.7 DATA VALIDATION

If radiological biased samples are collected, these sample results will be validated by a third-party validation company at 90 percent Stage 2B and 10 percent Stage 3. Data validation will be in accordance with the method requirements stated in the DoD QSM (2017), *Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP)* (MARLAP; EPA et al., 2004), and the QC criteria specified in this SAP. Additional validation guidance from *ANSI/ANS-41.5-2012: Verification and Validation of Radiological Data for Use in Waste Management and Environmental Remediation* (American Nuclear Society, 2012) and the *National Functional Guidelines for Inorganic Superfund Data Review* (EPA, 2014) will be used as necessary

Data will be validated and flagged with the following data qualifiers:

- ***J qualifier*** denotes the analyte was positively identified, but the associated numerical value is estimated.
- ***U qualifier*** denotes the analyte was analyzed for, but not detected. The associated numerical value is at or below the reporting limit.
- ***R qualifier*** denotes the data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.

SAP Worksheet #15.1: Reference Limits and Evaluation Table—Site Contaminants (Solid Matrix—Gamma Isotopes)

Analyte	CAS Number	Units	Project Action Limit[1]	Project Action Limit Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						DLC[2]	LOD	DL
Actinium 228 (228Ac)	14331-83-0	pCi/g	NA	NA	NA	NA	NA	NA
Actinium-227 (227Ac)	14952-40-0	pCi/g	NA	NA	NA	NA	NA	NA
Bismuth-212 (212Bi)	14913-49-6	pCi/g	NA	NA	NA	NA	NA	NA
Bismuth-214(^{214}Bi)	14733-03-0	pCi/g	NA	NA	NA	NA	NA	NA
Cesium-137 (137Cs)	10045-97-3	pCi/g	0.113	AM Release Criteria	0.07	0.07[2]	NA	NA
Cobalt-60 (60Co)	10198-40-0	pCi/g	NA	NA	NA	NA	NA	NA
Lead-210 (210Pb)	14255-04-0	pCi/g	NA	NA	NA	NA	NA	NA
Lead-212 (212Pb)	15092-94-1	pCi/g	NA	NA	NA	NA	NA	NA
Lead-214 (214Pb)	15067-28-4	pCi/g	NA	NA	NA	NA	NA	NA
Potassium-40 (40K)	13966-00-2	pCi/g	NA	NA	NA	NA	NA	NA
Protactinium-231 (231Pa)	15100-28-4	pCi/g	NA	NA	NA	NA	NA	NA
Radium-226 (226Ra)	13982-63-3	pCi/g	1.0 above background[2]	AM Release Criteria	0.2	0.2[2]	NA	NA
Radium-228 (228Ra)	15262-20-1	pCi/g	NA	NA	NA	NA	NA	NA
Thallium-208 (208Tl)	14913-50-9	pCi/g	NA	NA	NA	NA	NA	NA
Thorium-228 (^{228}Th)	14274-82-9	pCi/g	NA	NA	NA	NA	NA	NA
Thorium-232 (^{232}Th)	7440-29-1	pCi/g	NA	NA	NA	NA	NA	NA
Thorium-234 (^{234}Th)	15065-10-8	pCi/g	NA	NA	NA	NA	NA	NA
Uranium-235 (^{235}U)	15117-96-1	pCi/g	NA	NA	NA	NA	NA	NA
Uranium-238 (^{238}U)	7440-61-1	pCi/g	NA	NA	NA	NA	NA	NA

SAP Worksheet #15.1: Reference Limits and Evaluation Table—Site Contaminants (Solid Matrix—Gamma Isotopes) (continued)

Notes:

[1] The project action limits are based on EPA preliminary remediation goals as cited in the AM (Navy, 2006) and are in addition to background values for these radionuclides.

[2] ^{226}Ra background for definitive data is 0.633 picocurie per gram (pCi/g) for this project.

[3] Decision level concentration (DLC) at or less than the value listed are goals for ^{137}Cs and ^{226}Ra for samples for this project. Project DLCs for radiological analyses are calculated on a sample specific basis and will vary. The values listed indicate a minimum DLC that will be achieved for the majority of samples, under normal analytical conditions. For samples reported as undetected (U-qualified), the DLC can be highly variable. For samples reported as undetected with positive results, if the DLC exceeds the release criteria, the laboratory will be requested to recount the samples to allow re-evaluation of the reported sample results.

DLC for other radionuclides analyzed by gamma spectroscopy are not required to be achieved unless specifically requested on the applicable COC.

DL	*detection limit*
NA	*not applicable, not an ROC for the site, but reported in the laboratory gamma spec standard list*

SAP Worksheet #15.2: Reference Limits and Evaluation Table—Site Contaminants (Solid Matrix—Strontium-90)

Analyte	CAS Number	Units	Project Action Limit [1]	Project Action Limit Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						DLC	LOD	DL
Total Strontium	7440-24-6	pCi/g	0.331	Release Criteria	0.16	0.16	NA	NA
Strontium-90 (^{90}Sr)	10098-97-2	pCi/g	0.331	Release Criteria	0.16	0.16	NA	NA

Notes:

Total strontium analysis will be performed first by the laboratory since strontium isotopes (not including ^{90}Sr) have decays away since activities involving radioactive material ceased at HPNS. If the total strontium result is less than the release criterion, a ^{90}Sr specific analysis is not required. If the total strontium result is above the release criterion, then a ^{90}Sr specific analysis will be performed.

[1] The project action limits are based on EPA preliminary remediation goals as cited in the AM (Navy, 2006) and are in addition to background values for these radionuclides.

DL — *detection limit*
NA — *not applicable*

SAP Worksheet #15.3: Reference Limits and Evaluation Table—Site Contaminants (Solid Matrix—Alpha Isotopes)

Analyte	CAS Number	Units	Project Action Limit [1]	Project Action Limit Reference	Project Quantitation Limit Goal	Laboratory-Specific		
						DLC	LOD	DL
Plutonium-239/240	10-12-8	pCi/g	2.59	Release Criteria	0.10	0.10	NA	NA

Notes:

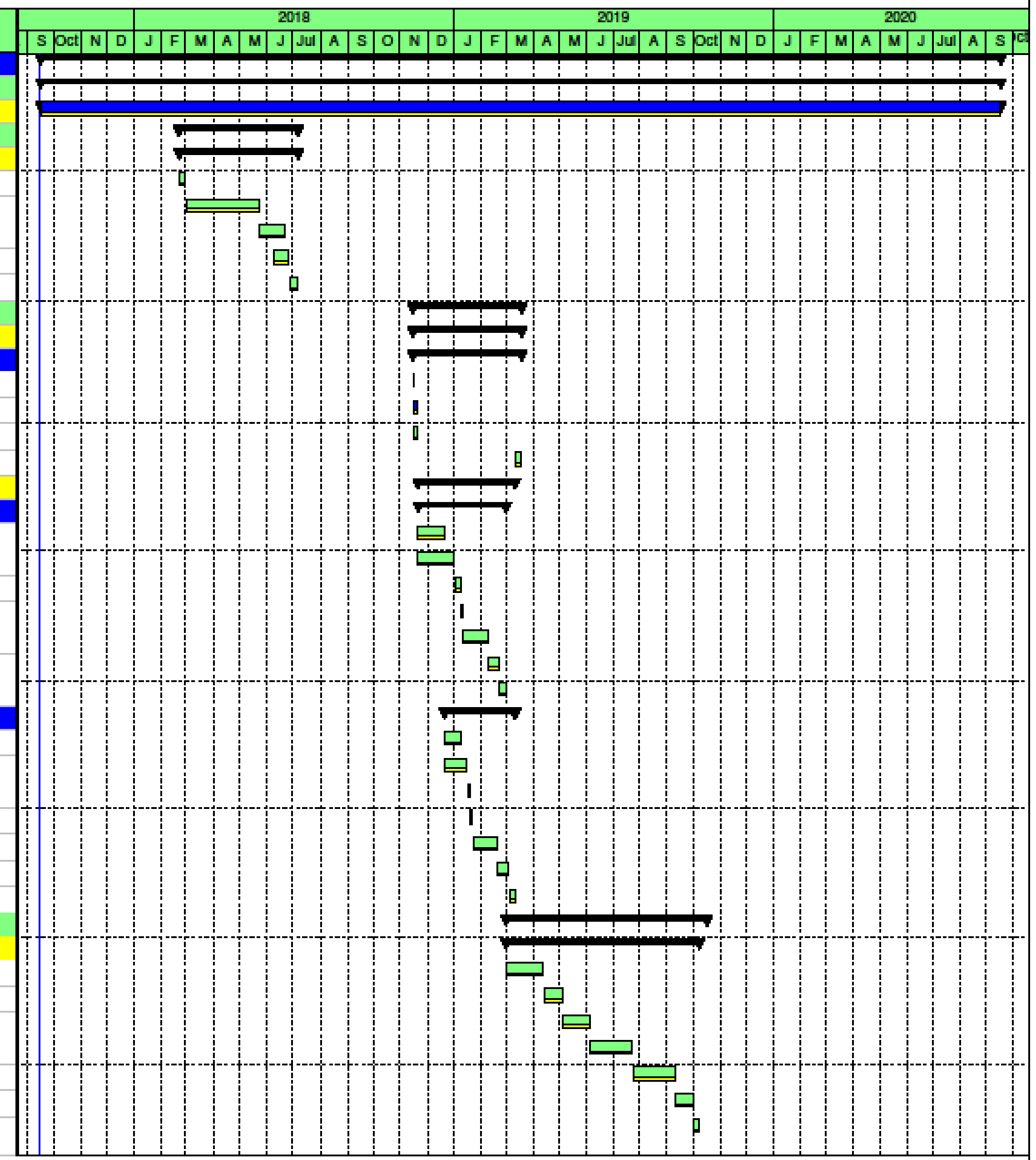
[1] The project action limit is based on EPA preliminary remediation goal as cited in the AM (Navy, 2006) and is in addition to the background value for this radionuclide.

DL — *detection limit*
NA — *not applicable*

SAP Worksheet #16: Project Schedule/Timeline Table

Run Date: 27-Jun-18 Data Date: 15-Sep-17 1 of 2

Activity Name	Original Duration	Start	Finish
DO 4550 Radiological Work Tasks at Parcels C, D-1, and F, Hunters Point Naval Shipyard	757	15-Sep-17	16-Sep-20
Work Element 1- Project Management Support	757	15-Sep-17	16-Sep-20
Project Mgmt - Project Management & Administrative Support	757	15-Sep-17	16-Sep-20
Work Element 3 - Planning Documents	95	21-Feb-18	06-Jul-18
Parcel F Structures (Piers and Submarine Pens)	95	21-Feb-18	06-Jul-18
Issue Draft Work Plan	6	21-Feb-18	28-Feb-18
Regulatory Review of Draft Work Plan (45 Calendar Day Review)	70	01-Mar-18	22-May-18
Prepare and Issue Response to Comments on the Draft Work Plan	21	23-May-18	21-Jun-18
Navy Review of Response to Comments on the Draft Work Plan (21 Calendar Days)	13	08-Jun-18	26-Jun-18
Issue Final Work Plan	7	27-Jun-18	06-Jul-18
Work Element 4 - Field Work Activities	83	15-Nov-18	18-Mar-19
Pre-Construction Activities	83	15-Nov-18	18-Mar-19
Mobilization/Demobilization	83	15-Nov-18	18-Mar-19
Pre-Construction Meeting	1	15-Nov-18	15-Nov-18
Mobilization	3	16-Nov-18	20-Nov-18
Permitting and Notifications	4	16-Nov-18	21-Nov-18
Parecl F Demobilization	5	12-Mar-19	18-Mar-19
Parcel F Structures (Piers and Subpens)	74	21-Nov-18	11-Mar-19
Radiological Surveys of Finger Piers	67	21-Nov-18	28-Feb-19
Characterization Survey	20	21-Nov-18	20-Dec-18
Data Review	25	21-Nov-18	31-Dec-18
Follow Up Statics/Biased Samples	4	02-Jan-19	07-Jan-19
Ship Biased Samples, Logged by Lab	3	08-Jan-19	10-Jan-19
Sample Analysis	20	11-Jan-19	07-Feb-19
Review Data and Prepare Data Package	10	08-Feb-19	21-Feb-19
RASO Review and Approval of Packages	5	22-Feb-19	28-Feb-19
Radiological Surveys of Submarine Pens	54	21-Dec-18	11-Mar-19
Gamma Walk Over Survey/Collect Systematic Samples	10	21-Dec-18	08-Jan-19
Data Review	15	21-Dec-18	15-Jan-19
Follow Up Statics/Biased Samples	2	16-Jan-19	17-Jan-19
Ship Biased Samples, Logged by Lab	2	18-Jan-19	21-Jan-19
Sample Analysis	20	22-Jan-19	18-Feb-19
Review Data and Prepare Data Package	10	19-Feb-19	04-Mar-19
RASO Review and Approval of Packages	5	05-Mar-19	11-Mar-19
Work Element 5 - Reports and Data Submittal	160	01-Mar-19	16-Oct-19
Parcel F Structures Characterization Survey Report-Finger Piers	153	01-Mar-19	07-Oct-19
Prepare Internal Draft Characterization Survey Report	30	01-Mar-19	12-Apr-19
Navy Review of Internal Draft Characterization Survey Report (21 Calendar Days)	15	15-Apr-19	03-May-19
Respond to Navy Comments and Issue Draft Characterization Survey Report	22	06-May-19	05-Jun-19
Regulatory Review of Draft Characterization Survey Report (45 Calendar Day Review)	33	06-Jun-19	23-Jul-19
Prepare and Issue Draft Final Characterization Survey Report	33	24-Jul-19	09-Sep-19
Navy Review of Draft Final Characterization Survey Report	15	10-Sep-19	30-Sep-19
Respond to Regulatory Comments and Issue Final Characterization Survey Report	5	01-Oct-19	07-Oct-19



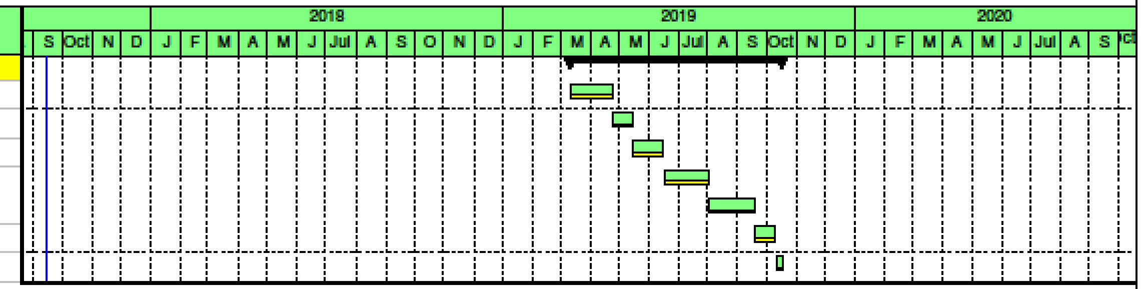
Project Baseline Bar
Summary
Actual Work
Remaining Work
Critical Remaining Work
Milestone

Project Schedule - Delivery Order: N6247317F4550
Parcel F Piers and Submarine Pens,
Hunters Point Naval Shipyard, San Francisco, CA
Figure 10 - Project Schedule

SAP Worksheet #16: Project Schedule/Timeline Table (continued)

Run Date: 27-Jun-18 Data Date: 15-Sep-17 2 of 2

Activity Name	Original Duration	Start	Finish
Parcel F Structures Characterization Survey Report-Submarine Pens	153	12-Mar-19	16-Oct-19
Prepare Internal Draft Characterization Survey Report	30	12-Mar-19	23-Apr-19
Navy Review of Internal Draft Characterization Survey Report (21 Calendar Days)	15	24-Apr-19	14-May-19
Respond to Navy Comments and Issue Draft Characterization Survey Report	22	15-May-19	14-Jun-19
Regulatory Review of Draft Characterization Survey Report (45 Calendar Day Review)	33	17-Jun-19	01-Aug-19
Prepare and Issue Draft Final Characterization Survey Report	33	02-Aug-19	18-Sep-19
Navy Review of Draft Final Characterization Survey Report	15	19-Sep-19	09-Oct-19
Respond to Regulatory Comments and Issue Final Characterization Survey Report	5	10-Oct-19	16-Oct-19



Project Baseline Bar
Summary
Actual Work
Remaining Work
Critical Remaining Work
Milestone

Project Schedule - Delivery Order: N6247317F4550
Parcel F Piers and Submarine Pens,
Hunters Point Naval Shipyard, San Francisco, CA
Figure 10 - Project Schedule

SAP Worksheet #17: Sampling Design and Rationale

Gamma surveys will be performed over 100 percent of the accessible surface of the Parcel F structures including the submarine pens and finger piers. Gamma surveys will be performed using the RS-700. In areas not accessible to the RS-700 such as the vertical surfaces along the submarine pens above the low tide line, gamma surveys will be performed using a handheld 3-inch by 3-inch sodium iodide radiological detector and suitable instrument (e.g., Ludlum Model 2221 ratemeter and Model 44-20 detector, or similar) coupled with the Global Positioning System.

Surveys consistent with MARSSIM guidance (NRC et al., 2000) for a Class 3 final status survey will be performed. Alpha/beta scan measurements will be performed over 25 percent of the accessible surface of the Parcel F structures. Static and removable measurements of alpha/beta activity will be performed at biased locations to investigate scan survey results. Static and removable measurements of alpha/beta activity will be performed at random locations consistent with MARSSIM guidance for Class 3 final status surveys.

17.1 BIASED RADIOLOGICAL CHARACTERIZATION SAMPLING

Samples will be collected as necessary and at the direction of the Navy to complete the investigation of the Parcel F structures in areas exhibiting discrete areas of elevated gamma count rate readings that exceed instrument-specific ILs and that are not attributable to naturally-occurring radioactivity.

If samples are submitted of off-site analysis, radiological data will be reported by the laboratory after an initial seven-day ingrowth period. If the analytical results of the soil indicate the ^{226}Ra concentration exceeds the screening criterion (1.633 pCi/g), or the criterion for ^{137}Cs (0.113 pCi/g), the soil is radiologically-impacted the results will be reported. If the analytical results indicate that the ^{226}Ra concentration is less than the screening criterion (1.633 pCi/g), the soil is not radiologically-impacted and, the samples will be recounted after a full 21-day ingrowth period and reported. If ^{90}Sr is detected above release criteria, then additional analysis for ^{239}Pu or other alpha emitters may be performed to confirm contamination. If the results following the full ingrowth are consistent with background and gamma count rate scanning and static measurements are below instrument-specific ILs, the radiological survey will be considered complete.

SAP Worksheet #18: Sampling Locations and Methods/Standard Operating Procedures Requirements Table

Sampling Location	Purpose	Sample Identification (ID) Number	Matrix	Depth (feet below ground surface)	Analytical Group	Number of Samples	Sampling SOP Reference
Biased Locations	Biased radiological samples as needed to support field gamma survey	F-B-XXX	Structural material (concrete, wood, etc.)	Surface	Gamma spec (^{226}Ra,^{137}Cs) Total Strontium/^{90}Sr ^{239}Pu (*only analyzed if* ^{90}*Sr detected above release criteria*)	If necessary to support field gamma scan surveys	Worksheet #14

SAP Worksheet #19: Analytical Standard Operating Procedures Requirements Table

Matrix	Analytical Group	Analytical and Preparation Method/ Reference	Sample Volume	Container	Preservation Requirements	Maximum Holding Time
Solid	Gamma Isotopes	EPA 901.1MOD	250 – 400 grams	One 250-mL poly/glass or tuna can	None	180 days
Solid	Total Strontium/ ^{90}Sr	EPA 905.0/Sr-02	250 – 400 grams	One 250-mL poly/glass or tuna can	None	180 days
Solid	^{239}Pu, alpha isotopic	U.S. Department of Energy (DOE) A-01-R	1 – 5 grams	One 250-mL poly/glass or tuna can	None	180 days

Notes:

mL *milliliter*

SAP Worksheet #20: Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Primary Sampling Locations	No. of Field Duplicates	No. of MS/MSDs	No. of Field Blanks	No. of Equipment Rinse Blanks	No. of Trip Blanks	Total No. of Samples to Laboratory
Solid	Gamma Isotopes Total Strontium ^{239}Pu	Collect as necessary to confirm to support surveys	None	None	None	None	None	To be determined based on gamma walkover survey results

Notes:

MSD *matrix spike duplicate*

SAP Worksheet #21: Project Sampling Standard Operating Procedures References Table

Reference Number	Title	Date, Revision and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
Worksheet #14	Chip Sampling	NA	APTIM	hammer, chisel, saw	Y	

Notes:

NA *not applicable*

SAP Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Verification Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Radiological controls portable instrument procedures are described in detail in the RPP (APTIM, 2017a) and work instructions					Project RSO or designee	Operation and use of portable instruments at HPNS (RPP [APTIM, 2017a]) Radiation Detection Instrumentation Work Instruction (AMS-710-07-WI-04014) [Attachment 2]

SAP Worksheet #23: Analytical Standard Operating Procedures References Table

Laboratory SOP Number[1]	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
ST-RD-0102	Gamma Vision Analysis,; 3/09/18	Definitive	Solids Gamma Isotopes (^{226}Ra and ^{137}Cs)	Gamma Spectrometer	TestAmerica	N
ST-RC-0025	Preparation of samples for gamma spectroscopy, 12/19/17	Definitive	Soil	Gamma Spectrometer	TestAmerica	N
ST-RD-0403	Low Background Gas Flow Proportional Counting System Analysis, 12/15/17	Definitive	Solids ^{90}Sr	Gas Flow Proportional Counter	TestAmerica	N
ST-RD-0210	Alpha Spectroscopy Analysis Revision 3/9/18	Definitive	Solids Alpha Isotopes	Alpha Spectrometer	TestAmerica	N
ST-RC-0058	Soil Sample preparation for Strontium-89, Strontium-90 and total strontium using extraction chromatography, 12/12/17	Definitive	Soil	Gas Flow Proportional Counter	TestAmerica	N

Notes:

[1]Portable document format copies of analytical SOPs will be provided in the Final SAP (Attachment 2).

SAP Worksheet #24.1: Analytical Instrument Calibration Table (Gamma Spectrometry)

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
Gamma Spectrometry	ICAL	Prior to initial use, following repair or loss of control and upon incorporation of new or changed instrument settings (MARLAP [EPA et al., 2004] 18.5.6.2;)	Verify manufacturer's specifications for gamma peak resolution (MARLAP 18.5.6.2) Efficiency vs. energy for each geometry/matrix 95 percent (%) confidence limit of the fitted function: less than or equal to (≤) 8% over energy range (MARLAP 18.5.6.2) or peak energy difference is within 0.1 kiloelectron volt (keV) of reference energy for all points Peak full width at half maximum (FWHM) less than (<) 2.5 keV at 1,332 keV Energy vs. channel slope equation shall be linear and accurate to 0.5 keV	Correct problem, then repeat ICAL	Laboratory Manager/Analyst	ST-RD-0102
	ICAL verification (ICV)	After ICAL for energy/efficiency and prior to analysis of samples	Observed peaks of second source standard fall within plus or minus (±) 10% of ICAL value relative to energy, FWHM, and efficiency	Verify second source standard and repeat ICV to check for errors If that fails, identify and correct problem and repeat ICV or ICAL and ICV as appropriate	Laboratory Manager/Analyst	

SAP Worksheet #24.1: Analytical Instrument Calibration Table (Gamma Spectrometry) (continued)

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
Gamma Spectrometry (continued)	Continuing calibration verification (CCV) (Daily Check)	Daily or prior to use When working with long count times or batch sequences that run more than a day, CCV is performed at the beginning and end of each analytical batch as long as it no longer than a week	Verify peak shift within tolerance limit; verify efficiency within control parameters; verify resolution in tolerance limit Response checks shall have a tolerance limit or control chart set at ± 3% or 3σ of the mean (MARLAP 18.5.6.2); or peak Energy/Efficiency: low, mid, and high energies within 10% of the ICAL value; FWHM: low, mid, and high energies within 10% of initial FWHM value	Correct problem, rerun CCV If that fails, then repeat ICAL Reanalyze samples since the last successful calibration verification	Laboratory Manager/Analyst	ST-RD-0102
	Background subtraction count (BSC) measurement (long count for subtracting background from blanks or test sources)	Immediately after ICAL and then performed on at least a monthly basis (MARLAP 18.5.6.2)	Statistical test of successive counts and count rates for identified background peaks show no significant difference (MARLAP 18.5.6.2)	Recount and check control chart for trends Determine cause, correct problem, re-establish BSC If background activity has changed, re-establish BSC and reanalyze or qualify impacted samples since last acceptable BSC	Laboratory Manager/Analyst	

SAP Worksheet #24.2: Analytical Instrument Calibration Table (Alpha Spectrometry)

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
Alpha Spectrometry	ICAL	Prior to initial use, following repair or loss of control and upon incorporation of new or changed instrument settings (MARLAP 18.5.6.2; EPA et al., 2004)	Verify manufacturer's specifications for source efficiency (MARLAP); and two calibration peaks that are: 1) greater than or equal to (≥)700 keV apart; or 2) that bracket peaks to be determined Energy vs. channel slope equation <15 keV per channel Full Width –Half Maximum (FWHM) <100 keV for each peak used for calibration Minimum of 3,000 net counts in each peak	Correct problem, then repeat ICAL	Laboratory Manager/Analyst	ST-RD-0210
	ICV	After ICAL	Determine peak location, resolution, and radionuclide of interest/alpha peak efficiency (where counting efficiency is an analytical requirement) using at least two alpha peaks (MARLAP 18.5.6.3) Or Observed peak centroid falls within ±20 keV from reference energyfor each peak used in the initial energy calibration FWHM ≤100 keV and within ±20 keV of corresponding calibration peaks in initial energy calibration	Repeat ICV to check for error If that fails, identify and correct problem and repeat ICV or ICAL and ICV, as appropriate	Laboratory Manager/Analyst	

SAP Worksheet #24.2: Analytical Instrument Calibration Table (Alpha Spectrometry) (continued)

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
Alpha Spectrometry (continued)	CCV (Pulsar Check)	Pulsar energy verification weekly, prior to analysis of samples Use either pulsar check or check source	Energy response check shall have a tolerance limit set at ± 3% or control chart set at ± 3σ (MARLAP 18.5.6.3) or observed peak centroid falls ≤20 keV from reference energy	Recount and check control chart for trends Determine cause, correct problem, and repeat CCV and associated samples since last successful CCV	Laboratory Manager/Analyst	ST-RD-0210
	CCV (Check Source)	Weekly source check verification prior to analysis of samples Use either pulsar check or check source	Response checks shall have a tolerance limit or control chart set at ± 3% or 3σ (MARLAP 18.5.6.3) or observed peak centroid falls within 20 keV from reference energy for each peak used in the initial energy calibration FWHM ≤100 keV and within 30 keV of corresponding calibration peaks in initial energy calibration	Recount and check control chart for trends Determine cause, correct problem, and repeat CCV and associated samples since last successful CCV	Laboratory Manager/Analyst	

SAP Worksheet #24.2: Analytical Instrument Calibration Table (Alpha Spectrometry) (continued)

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
Alpha Spectrometry (continued)	BSC	Prior to initial use or after ICAL and monthly (MARLAP 18.5.6.3)	Within ±3σ of mean activity of recent BSCs for total radionuclide of interest for isotopes of interest (minimum of three BSC values)	Recount and check control chart for trends Determine cause, correct problem, re-establish BSC If background activity has changed, re-establish BSC and reanalyze or qualify impacted samples since last acceptable BSC	Laboratory Manager/Analyst	ST-RD-0210

SAP Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Gamma Spectroscopy	Efficiency check	CCV count	Multipoint	Daily	±3 standard deviations	Recount	Analyst/ Department Manager	ST-RD-0102
Gamma Spectrometer	1. Clean cave; fill dewar with nitrogen gas 2. QA check	1. Physical check 2. Background and source check	1. Physical check 2. Check deviation	1. Weekly 2. Daily	1. Acceptable background 2. Within 2 sigma of measured population	Recalibrate Instrument maintenance Consult with Technical Director	Analyst/ Department Manager	ST-RD-0102
Gas Flow Proportional Counting	1. Check counting gas and change when < 500 pounds per square inch. 2. QA check	1. Physical check 2. Background and source check	1. Physical check 2. Check deviation	1. Weekly 2. Daily	1. Acceptable background 2. Within 2 sigma of measured population	Recalibrate Instrument maintenance Consult with Technical Director	Analyst/ Department Manager	ST-RD-0403
	Efficiency check	CCV count	Multipoint	Daily	±3 standard deviations	Recount	Analyst/ Department Manager	ST-RD-0102

SAP Worksheet #26: Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): APTIM—Field Technician
Sample Packaging (Personnel/Organization): APTIM—Field Technician
Coordination of Shipment (Personnel/Organization): APTIM—Field Technician
Type of Shipment/Carrier: Laboratory Courier—UPS or FedEx
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization):TestAmerica (Sample Receiving)
Sample Custody and Storage (Personnel/Organization): TestAmerica (Sample Receiving)
Sample Preparation (Personnel/Organization): Subcontract Laboratory—TestAmerica Analytical Chemist
Sample Determinative Analysis (Personnel/Organization): Subcontract Laboratory—TestAmerica Analytical Chemist
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): Shipped to laboratory the same day as collection if possible, if not possible to ship the same day; storage on site in cooler in locked building
Laboratory Sample Storage (No. of days from sample collection): Minimum three months TestAmerica
Sample Extract/Digestate Storage (No. of days from extraction/digestion): 30 days—TestAmerica
Biological Sample Storage (No. of days from sample collection): Not applicable to this project
SAMPLE DISPOSAL
Personnel/Organization: TestAmerica
Number of Days from Analysis: Three months

SAP Worksheet #27: Sample Custody Requirements Table

27.1 SAMPLE CUSTODY AND DOCUMENTATION

Sampling information will be recorded on a COC Form and in a permanently bound field logbook. Entries will be legible and recorded in indelible ink.

27.2 SAMPLE LABELING

Sample labels will be filled out with indelible ink and affixed to each sample container. Non-waterproof sample labels will be covered with clear tape. Sample containers will be placed in resealable plastic bags to protect the sample from moisture during transportation to the laboratory.

Each sample container will be labeled with the following, at a minimum:

- Sample identification number
- Sample collection date (month/day/year)
- Time of collection (24-hour clock)
- Project number
- Sampler's initials
- Analyses to be performed
- Preservation (if any)
- Location (i.e., site name)

27.3 CHAIN OF CUSTODY

An example COC Form is shown in Attachment 1. In addition to providing a custody exchange record for the samples, the COC Form serves as a formal request for sample analyses. The COC will be completed, signed, and distributed as follows:

- One copy retained by the sample coordinator for inclusion in the project files
- Original sent to the analytical laboratory with the sample shipment

After the laboratory receives the samples, the Sample Custodian will inventory each shipment before signing for it, and note on the original COC Form any discrepancy in the number of samples, temperature of the cooler, or broken samples. The Project Chemist will be notified immediately of any problems identified with shipped samples. The Project Chemist will, in turn, notify the Project QC Manager, and together they will determine the appropriate course of action. The Project Chemist will also notify the PM if the project budget and schedule may be impacted.

The laboratory will initiate an internal COC Form that will track the sample within the various areas of the laboratory. The relinquishing signature of the Sample Custodian and the custody acceptance signature of the laboratory personnel transfer custody of the sample. This procedure is followed each time a sample changes hands. The laboratory will archive the samples and maintain their custody as required by the contract, or until further notification from the Project Chemist, at which time the samples will either be returned to the project for disposal, or disposed by the laboratory.

27.4 SAMPLE PACKING AND SHIPMENT

After sample collection, sample labels will be affixed to each sample container. Each sample will be placed in a resealable plastic bag to keep the sample container and the label dry.

Sample containers from radiological areas will be screened in the field prior to shipping to the laboratory following Work Instruction WI-40113 of the RPP (APTIM, 2017a). The field exposure rate collected on the sample container is entered on the COC. Samples to be shipped by commercial carrier will be packed in a sample cooler lined with a plastic bag. Sample cooler drain spouts will be taped from the inside and outside of the cooler to prevent any leakage. Saturday deliveries will be coordinated with the laboratory.

If samples are picked up by a laboratory courier service, the COC Form will be completed and signed by the laboratory courier. The cooler will then be released to the courier for transportation to the laboratory.

If a commercial carrier is used, the COC Form will include the air bill number in the “Transfers Accepted By” column, and will be sealed in a resealable bag. The COC Form will then be taped to the inside of the sample cooler lid. The cooler will be taped shut with strapping tape, and two custody seals will be taped across the cooler lid. Clear tape will be applied to the custody seals to prevent accidental breakage during shipping. The samples will then be shipped to the analytical laboratory. A copy of the courier air bill will be retained for documentation.

The shipping of samples to the analytical laboratory by land delivery services will be performed according to the U.S. Department of Transportation regulations. The International Air Transportation Association regulations will be adhered to when shipping samples by air courier services. Transportation methods will be selected to ensure that the samples arrive at the laboratory in time to permit testing according to established holding times and project schedules. No samples will be accepted by the receiving laboratory without a properly prepared COC Form and properly labeled and sealed shipping container(s).

27.5 FIELD LOGBOOKS

A permanently bound field logbook with consecutively numbered pages will be assigned to this project. A sample collection log work sheet is provided in Attachment 1. Entries will be recorded in indelible ink. Corrections will be made following the procedure described in Section 27.6. At the end of each workday, the responsible sampler will sign the logbook pages, and any unused portions of a logbook page will be crossed-out, signed, and dated.

At a minimum, the logbook will contain the following information:

- Project name and location (on the front page of the log book)
- Date and time of collection for each sample (in the upper right corner of each page)
- Sample number
- Sample location (i.e., soil boring or sampling point)
- Sample type (i.e., soil and water)
- Composite or grab
- Composite type (the number of grab samples)
- Depth of sample
- Weather information (e.g., rain, sunny, approximate temperature)
- Containers used and requested analyses

In the graph paper portion of the field logbook, the sampler will fill in the following information:

- A map with sample locations (drawn or paste copy). Each sample location must be clearly identified on the map. Several sample locations may be presented on one map; however, the page with the map must be referred on each of the individual sample pages.
- Field analyses performed, including results, instrument checks, problems, and calibration records for field instruments.
- Descriptions of deviations from this SAP.
- Problems encountered and corrective action taken.
- Identification of field QC samples.
- List of QC activities.
- Verbal or written instructions from the Navy and APTIM Project QC Manager.

The sampler will cross-out the unused portion and sign each page.

27.6 DOCUMENT CORRECTIONS

Changes or corrections on any project documentation will be made by crossing-out the item with a single line, initialing by the person performing the correction, and dating the correction. The original item, although erroneous, will remain legible beneath the cross-out. The new information will be written above the crossed-out item. Corrections will be written clearly and legibly with indelible ink.

SAP Worksheet #28.1: Laboratory Quality Control Samples Table (Gamma Isotopes)

Matrix: Solid

Gamma Radionuclides

EPA 901.1M/SOP ST-RD-0102

QC Check	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator	Measurement Performance Criteria
Method Blank	One per analytical batch	$\lvert Z_{Blank} \rvert \leq 3$ for blank subtracted (net) activity in radionuclides of interest (MARLAP 18.4.1; EPA et al., 2004) Or No analytes detected greater than (>) 2 times the blank combined standard uncertainty Blank result must not otherwise affect sample results	Recount the blank to confirm results, unless sample results are >5 times the blank activity Inspect method blank control chart for indication of significant bias If required, reprep and reanalyze method blank and samples processed with the contaminated blank	Laboratory Manager/Analyst	A means of assessing the existence and magnitude of contamination introduced via the analytical process	No analytes detected > 2 times the blank combined standard uncertainty. Blank result must not otherwise affect sample results
LCS	One per analytical batch	$\lvert Z_{LCS} \rvert \leq 3$. Investigate recurrent results with $\lvert Z_{LCS} \rvert \geq 2$ (MARLAP 18.4.3) Or Use in-house control chart limits of ± 3σ of the mean In-house control limits may not fall more than 25% from the known LCS value	Recount the LCS to confirm results Inspect LCS control chart for indication of significant bias If required, reprep and reanalyze the LCS and associated samples	Laboratory Manager/Analyst	Accuracy	In-house control chart limits of ± 3σ of the mean In-house control limits may not fall more than 25% from the known LCS value

SAP Worksheet #28.1: Laboratory Quality Control Samples Table (Gamma Isotopes) (continued)

Matrix: Solid						
Gamma Radionuclides						
EPA 901.1M/SOP ST-RD-0102						
QC Check	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator	Measurement Performance Criteria
Sample Duplicate	One per analytical batch	|ZDup | ≤ 3. Investigate recurrent results with |ZDup|≥ 2 (MARLAP 18.4.1; EPA et al., 2004) Or the duplicate error ratio (DER) between the sample and the duplicate is <3; or the relative percent difference (RPD) is <25%	Check for lab error. Examine the project-specific requirements Contact the client as to additional measures to be taken	Laboratory Manager/ Analyst	Precision	The DER between the sample and the duplicate is <3; or the RPD is <25%

SAP Worksheet #28.2: Laboratory Quality Control Samples Table (Gas Flow Proportional Counting Isotopes)

Matrix: Solid

Beta Emitting Radionuclides

EPA 905/ST-RD-0403

QC Check	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator	Measurement Performance Criteria
Instrument Contamination Check	Daily or when working with long count times, before and after each analytical batch Check after counting high activity samples	Use a statistical test to determine a change in the background count rate value (MARLAP 18.5.6.4; EPA et al., 2004) Or within ±3σ of mean activity of recent BSCs (minimum of 3 BSCs)	Recount the background. If still out of control, locate and correct problem; reanalyze or qualify impacted samples since last acceptable instrument contamination check If background activity has changed, re-establish BSC and reanalyze samples	Laboratory Manager/ Analyst	A means of assessing the existence and magnitude of contamination introduced via the analytical process	Within ±3σ of mean activity of recent BSCs (minimum of three BSCs)
LCS	One per analytical batch	$\lvert Z_{LCS} \rvert \leq 3$. Investigate recurrent results with $\lvert Z_{LCS} \rvert \geq 2$ (MARLAP 18.4.3; EPA et al., 2004) Or use in-house control chart limits of ±3σ of the mean In-house control limits may not fall more than 25% from the known LCS value	Recount the LCS to confirm results. Inspect LCS control chart for indication of significant bias If required, reprep and reanalyze the LCS and associated samples	Laboratory Manager/ Analyst	Accuracy	$\lvert Z_{LCS} \rvert \leq 3$. Investigate recurrent results with $\lvert Z_{LCS} \rvert \geq 2$ Or Use in-house control chart limits of ±3σ of the mean not more than 25% from the known LCS value.

SAP Worksheet #28.2: Laboratory Quality Control Samples Table (Gas Flow Proportional Counting Isotopes) (continued)

Matrix: Solid

Beta Emitting Radionuclides

EPA 905/ST-RD-0403

QC Check	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator	Measurement Performance Criteria
MS	One per preparatory batch (MS not required when yield tracers are employed)	If activity of the MS > 5 times the unspiked sample, |ZMS |≤ 3 (MARLAP 18.4.3; EPA et al., 2004) Or within 60 – 140% recovery	Examine the project-specific requirements Contact the client as to additional measures to be taken	Laboratory Manager/ Analyst	Accuracy	If activity of the MS > 5 times the unspiked sample, |ZMS |≤ 3 (MARLAP 18.4.3) or Within 60 – 140% recovery
Sample Duplicate	One per analytical batch	|ZDup | ≤ 3. Investigate recurrent results with |ZDup|≥ 2 (MARLAP 18.4.1) Or the DER between the sample and the duplicate is <3; or the RPD is <25%.	Check for lab error. Examine the project-specific requirements Contact the client as to additional measures to be taken	Laboratory Manager/ Analyst	Precision	Act < 5*MDC, then RPD is 100% or less. If act > 5*MDC, then RPD is 25% or less or DER</=3

SAP Worksheet #28.3: Laboratory Quality Control Samples Table (Alpha Spectroscopy)

Matrix: Solid

Alpha Spectroscopy

DOE A-01-R MOD/SOP ST-RD-0210

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator	Measurement Performance Criteria
Method Blank	One per preparatory batch (MARLAP 18.4.1; EPA et al., 2004)	$\|Z_{Blank}\| \leq 3$. Investigate recurrent results with $\|Z_{Blank}\| \geq 2$ (MARLAP 18.4.1) Or in-house control limits of ±3 σ of the mean	Recount the blank to confirm results. Inspect method blank control chart for indication of significant bias If required, reprep and reanalyze method blank and samples processed with the contaminated blank	Laboratory Manager/ Analyst	Accuracy	$\|Z_{Blank}\| \leq 3$. Investigate recurrent results with $\|Z_{Blank}\| \geq 2$ Or In-house control limits of ±3 σ of the mean
LCS	1 per preparatory batch	$\|Z_{LCS}\| \leq 3$. Investigate recurrent results with $\|Z_{LCS}\| \geq 2$ (MARLAP 18.4.3) Or use in-house control chart limits of ± 3σ of the mean In-house control limits may not fall more than 25% from the known LCS value.	Recount the LCS to confirm results Inspect LCS control chart for indication of significant bias If required, reprep and reanalyze the LCS and associated samples	Laboratory Manager/ Analyst	Accuracy	Control chart limits of ± 3σ of the mean In-house control limits may not fall more than 25% from the known LCS value

SAP Worksheet #28.3: Laboratory Quality Control Samples Table (Alpha Spectroscopy) (continued)

Matrix: Solid

Alpha Spectroscopy

DOE A-01-R MOD/SOP ST-RD-0210

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator	Measurement Performance Criteria
MS	One per preparatory batch (MS not required when yield tracers are employed)	If activity of the MS > 5 times the unspiked sample, |ZMS |≤ 3 (MARLAP 18.4.3) Or within 60 – 140% recovery	Examine the project-specific requirements Contact the client as to additional measures to be taken	Laboratory Manager/ Analyst	Accuracy	If activity of the MS > 5 times the unspiked sample, |ZMS |≤ 3 (MARLAP 18.4.3) Or within 60 – 140% recovery
Tracers	Added to each sample as isotopic yield monitor	Isotopic yield within 30 – 110% FWHM < 100 keV and peak energy within ± 40 keV of known peak energy.	Reanalysis of sample, including sample preparation	Laboratory Manager/ Analyst	Accuracy	Isotopic yield within 30 – 110%
Sample Duplicate	One per analytical batch	|ZDup | ≤ 3. Investigate recurrent results with |ZDup|≥ 2 (MARLAP 18.4.1) Or the DER between the sample and the duplicate is <3; or the RPD is <25%	Check for lab error. Examine the project-specific requirements Contact the client as to additional measures to be taken	Laboratory Manager/ Analyst	Precision	RPD is 25% or less or DER</=3

SAP Worksheet #29: Project Documents and Records Table

Document	Where Maintained
Final Work Plan and SAP	APTIM project file (APTIM Concord, California office) NAVFAC SW Environmental Restoration Program Record File for CERCLA sites
Field notes/logbook	APTIM project file (APTIM Concord, California office) NAVFAC SW Environmental Restoration Program Record File for CERCLA sites
COC forms	APTIM project file (APTIM Concord, California office) NAVFAC SW Environmental Restoration Program Record File for CERCLA sites
Laboratory raw data package	APTIM project file (APTIM Concord, California office) NAVFAC SW Environmental Restoration Program Record File for CERCLA sites
Audit/assessment checklists/reports	APTIM project file (APTIM Concord, California office) and laboratory NAVFAC SW Environmental Restoration Program Record File for CERCLA sites
Corrective action forms/reports	APTIM project file (APTIM Concord, California office) and laboratory
Laboratory equipment calibration logs	APTIM project file (APTIM Concord, California office) and laboratory
Sample preparation logs	APTIM project file (APTIM Concord, California office) and laboratory
Run logs	APTIM project file (APTIM Concord, California office) and laboratory
Sample disposal records	APTIM project file (APTIM Concord, California office) and laboratory
Data validation reports and validated data	APTIM project file (APTIM Concord, California office) NAVFAC SW Environmental Restoration Program Record File for CERCLA sites

SAP Worksheet #30: Analytical Services Table

Matrix	Analytical Group	Sample Locations/ ID Numbers	Analytical Method	Data Package Turnaround Time	Laboratory/Organization[1] (Name, Address, Contact, and Telephone No.)	Backup Laboratory (Name, Address, Contact, and Telephone No.)
Solid	Gamma Spec ^{90}Sr Alpha Spec	Radiological samples shown in Worksheet #18	All	7 to 28 calendar days	Test America St. Louis Laboratory Contact: Rhonda Ridenhower 13715 Rider Trail North Earth City, Missouri 63045 314.298.8566	Curtis & Tompkins 2323 5th Street Berkeley, California 94710 510.486.0900

Notes:

[1] Analytical laboratories performing analyses will be State of California and DoD Environmental Laboratory Accreditation Program-accredited laboratories.

SAP Worksheet #31: Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing Corrective Actions	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions
Laboratory Technical Systems Audit	If deemed necessary prior to start of sampling activities	External	APTIM	APTIM Project or Program Chemist	Laboratory QA Officer	Laboratory QA Officer	Laboratory QA Officer and APTIM Project Chemist
Initial Inspection/Preparatory Meeting	Prior to the start of sampling activities	Internal	APTIM	APTIM Project or Program Chemist	Project Chemist or Sample Technician	Project Chemist or Sample Technician	Program Chemist or QC Manager
Field audits	If deemed necessary or as needed as the project progresses	Internal	APTIM and/or Navy QAO	APTIM Project or Program Chemist	Project Chemist or Program Chemist	Project Chemist or Program Chemist	Project Chemist or Program Chemist
Field documentation review	At least once at the beginning of sampling activities and then as needed as the project progresses	Internal	APTIM	APTIM Program Chemist or Field QA Manager	APTIM PM; Field Sampling Technician or Project Chemist	APTIM PM; Field Sampling Technician or Project Chemist	APTIM Program Chemist or Field QA Manager

SAP Worksheet #32: Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response	Timeframe for Response
Field Sampling Technical Systems Audit	Written Audit Report	Project PM	48 hours after audit	Email or letter	Field Technician, APTIM Project Chemist, APTIM Program Chemist	24 hours after notification
Off-Site Laboratory Audit (if performed for project)	Written Audit Report	Laboratory QA Manager, Laboratory PM (TestAmerica St. Louis)	5 days after audit	Corrective Action Plan	Field Technician, APTIM Project Chemist, APTIM Program Chemist	10 business days after receiving report
Laboratory Data Review Findings	Memorandum	Laboratory QA Manager, Laboratory PM (TestAmerica St. Louis)	48 hours after audit	Email or letter	Field Technician, APTIM Project Chemist, APTIM Program Chemist	3 days after notification

SAP Worksheet #33: QA Management Reports Table

Type of Report	Frequency	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Field Sampling Technical System Audit Report	At least once at the beginning of sampling activities and then as needed as the project progresses	Within 24 hours of field sampling audit	APTIM QA Manager or APTIM Project Chemist	APTIM PM
Off-Site Laboratory Technical System Audit Report (if performed)	Prior to sample receipt at laboratory	Within 48 hours of on-site audit	APTIM Project Chemist or APTIM Program Chemist	Laboratory QA Manager, Laboratory PM
Data Review Report	After waste sample data reviewed by Project Chemist	As received from laboratory	APTIM Project Chemist or APTIM Program Chemist	APTIM PM
Final Project Report (if needed)	After completion of fieldwork	Project document delivery schedule is provided in the Work Plan	APTIM PM	Navy RPM and regulatory agencies (see distribution list)

SAP Worksheets #34-36: Data Verification and Validation (Steps I and IIa/IIb) Process Table

Data Review Input	Description	Responsible for Verification	Step I/IIa/IIb[1]	Internal/External
COC forms	COC forms will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the COC Form should be initialed by the reviewer, a copy of the COC Form retained in the project file, and the original and remaining copies taped inside the cooler for shipment.	Field sampling team leader (APTIM) or Project Chemist	Step I	Internal
Sample Release Survey	Sample release field survey data are included on the COC form to the laboratory. The sample survey data are reviewed and approved prior to sample shipment.	Field radiological sampling team leader (APTIM) or Project Chemist	Step I	Internal
Sample receipt	The sample cooler will be checked for compliance with preservative, temperature and packaging requirements. Sample containers will be reviewed against the COC for agreement. Sample receipt will be documented by the laboratory on a login sheet and sample information will be entered into the Laboratory Information Management System.	Laboratory sample receiving and PM	Step I	External
Field notes/logbook	Field notes will be reviewed internally and placed in the project file upon project completion.	APTIM Project Chemist and Field QC Manager	Step I	Internal
Audit reports	Upon report completion, a copy of audit reports will be placed in the project file. If corrective actions are required, a copy of the documented corrective action taken will be attached to the appropriate audit report in the project file. At the beginning of each week, and at the completion of the site work, project file audit reports will be reviewed internally to ensure that appropriate corrective actions have been taken and that corrective action reports are attached. If corrective actions have not been taken, the PM will be notified to ensure action is taken.	APTIM PM	Step I	Internal
Laboratory data packages	Laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal. Received data packages will be verified by the APTIM Chemist and a third-party reviewer according to the data validation procedures specified in this SAP.	Laboratory PM and APTIM Project Chemist	Step I	Internal/External

SAP Worksheets #34-36: Data Verification and Validation (Steps I and IIa/IIb) Process Table (continued)

Data Review Input	Description	Responsible for Verification	Step I/IIa/IIb[1]	Internal/External
EDD	EDDs will be verified internally by the subcontract laboratory for completeness and technical accuracy prior to submittal to APTIM. Received EDDs will be verified APTIM and/or the validation company against the hardcopy laboratory reports.	Laboratory, APTIM Chemist and a third-party data validation company	Step I	Internal/External
Sampling methods and procedures	Ensure that the required sampling methods were used to collect project samples, any field changes or deviations are noted in the field logbook. Review field sample collection logbooks for compliance with the approved SAP.	APTIM Project Chemist and Field QC Manager	Step IIa	Internal
Holding times	Ensure the samples were analyzed within the EPA holding times. If holding times were not met, verify that deviations were documented and proper notifications were made.	Laboratory PM	Step IIa	External
Analytes and project DLCs met	Ensure that the required list of analytes and that project-specific DLCs specified in this SAP are met and reported per project requirements.	Laboratory PM and Project Chemist	Step IIa	Internal/External
Hard copy data packages	Review data package for completeness.	Third-party validation company	Step IIb	External
Documentation of SAP QC sample results	Determine if SAP required QC samples were collected and met required control limits per SAP and DoD QSM (2017) requirements when applicable.	Third-party validation company	Step IIb	External
Radiological Analyses	If off-site laboratory analysis are performed, Review/validate laboratory data package for compliance with, DoD QSM (2017), MARLAP (2004), ANSI/ANS-41.5-2012 (American Nuclear Society, 2012), National Functional Guidelines (EPA 2014) and requirements in this approved SAP as applicable.	Third-party validation company	Step IIb	External

Notes:

[1] IIa = compliance with methods, procedures, and contracts (see Table 10, page 117, UFP-QAPP [EPA, 2005]).

IIb = comparison with measurement performance criteria in the SAP (see Table 11, page 118, UFP-QAPP [EPA, 2005]).

SAP Worksheets #34-36: Data Verification and Validation (Steps I and IIa/IIb) Process Table (continued)

VALIDATION OF LABORATORY DATA

Data validation is a systematic, independent process of reviewing a body of data to determine the analytical limitations of that data based on specific QC criteria. If off-site laboratory analyses are performed, a third-party data validation company will validate definitive-level project laboratory data for radiological samples at 90 percent Stage 2B and 10 percent Stage 3.

Data review and validation will be in accordance with the QA requirements and control limits specified in this project-specific Quality Assurance Project Plan and the following guidance, as appropriate to the analytical methods used:

- DoD QSM (2017)
- MARLAP (2004)
- *ANSI/ANS-41.5-2012: Verification and Validation of Radiological Data for Use in Waste Management and Environmental Remediation* (ANS, 2012)
- *National Functional Guidelines for Inorganic Superfund Data Review* (EPA, 2014)

The chemist or reviewer’s professional judgment will be used to evaluate data quality when called for in the National Functional Guidelines. Professional judgment will also be used where no clear policy exists, or when there is conflicting guidance on how data should be qualified.

Stage 2B and Stage 3 Data Validation Criteria and Checklist

For a Stage 2B data validation effort, data quality is assessed by comparing the parameters listed below to the appropriate criteria (or limits) as specified in the project SAP, DoD QSM (2017), or by EPA method-specific requirements. If calculations for quantitation are verified, it is done on a limited basis requires raw data (Stage 3) in addition to the standard data forms normally present in a data package.

Data review/validation may include the following QC elements shown in the following example validation checklist (depending on the analysis being reviewed):

Pass/Fail QC Criteria	Review/Validation Criteria (Stage 2B and 3)
	Sample Receipt and Preservation
	Laboratory Method Blanks/Instrument Blanks
	Verify gross count rate less than 2,000 counts per second
	LCS/LCSD Recoveries
	RPD Evaluation
	Laboratory Sample Duplicate Evaluation

Pass/Fail QC Criteria	Review/Validation Criteria (Stage 2B and 3)
	ICAL verification
	2nd source and annual source verifications are within limits
	Weekly calibration checks (^{137}Cs) are within expected values
	Analyte quantitation (calculation check)—Stage 3 Validation only

SAP Worksheet #37: Usability Assessment

37.1 DATA QUALITY ASSESSMENT REPORT

Based on data validation/review, the Project Chemist or Project RSO will determine if the project DQOs have been met and will determine data usability. To reconcile the collected data with project DQOs and to establish and document data usability, the data will be reviewed against data quality indicators (Section 37.2).

A data usability assessment based on data quality indicators will be performed for every data set subjected to Class 3 validation (SAP Worksheet #34-36). If necessary, the Project Chemist will prepare a data quality assessment (DQA) report. The DQA report will cover the following topics:

- Implementation of sampling design and analysis according to the approved SAP (or sample completeness and representativeness)
- Proper frequency of field QC samples and the adequacy of field decontamination procedures
- Accuracy and precision of the data collected
- Data comparability, if appropriate
- Data usability for project decisions

The DQA report will be included in the final project report.

37.2 DATA QUALITY INDICATORS

This subsection defines the data quality indicators and their use for assessment of data quality.

37.2.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions. The following equation illustrates the method for calculating the RPD to assess a method's precision:

$$\text{Precision as RPD} = \frac{2 \times |\text{Result-Duplicate Result}| \times 100\%}{\text{Result + Duplicate Result}}$$

The laboratory uses LCS/LCSD pairs to assess the precision of analytical procedures with one LCS/LCSD pair for every 20 samples. For radiochemical analyses, analytical precision will be calculated based on the sample and sample duplicate results.

The analytical laboratory will use DoD QSM (2017) acceptability limits for RPDs if available. If DoD limits are not available, then the laboratory will establish statistically based acceptability limits for RPDs for each method of analysis and sample matrix. The laboratory will review the

QC samples to ensure that internal QC data lie within the limits of acceptability. Any suspect trends will be investigated and corrective actions taken.

The analytical laboratory will use DoD QSM (2017) control limits if available; otherwise, the laboratory will have statistically based acceptability limits for RPDs established for each method of analysis and sample matrix. The laboratory will review the QC samples to ensure that internal QC data lie within the limits of acceptability. Any suspect trends will be investigated and corrective actions taken.

Due to the heterogeneous nature of site soil, field duplicates cannot be used to assess sampling precision; therefore, field duplicates will not be collected for this project.

37.2.2 Accuracy

Accuracy measures the bias of an analytical system by comparing the difference of a measurement with a reference value. The percent recovery of an analyte, which has been added to the environmental samples at a known concentration before extraction and analysis, provides a quantitation tool for analytical accuracy. The spiking solutions used for accuracy determinations are not used for instrument calibrations. The following equation illustrates how accuracy is evaluated:

$$\textit{Accuracy as percent recovery} = \frac{\textit{Spiked Sample Result-Sample Result x 100\%}}{\textit{Spiked Sample True Value}}$$

Percent recoveries for LCS and LCSD that are analyzed for every batch of up to 20 samples serve as a measure of analytical accuracy.

The laboratory will use DoD QSM (2017) control limits for accuracy if available. For analytes not specified in the QSM, the laboratory may use statistically based control limits that are developed for each method of organic analysis and sample matrix.

Control limits are defined as the mean recovery, plus or minus three standard deviations, of the 20 data points, with the warning limits set as the mean plus or minus two standard deviations. The laboratory will review the QC samples each analysis to ensure that internal QC data lie within the limits of acceptability. The laboratory will investigate any suspect trends and take appropriate corrective actions.

37.2.3 Representativeness

Unlike precision and accuracy, which can be expressed in quantitative terms, representativeness is a qualitative parameter. Representativeness is the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. It is a qualitative parameter that depends on proper design of the sampling program.

Field personnel will be responsible for ensuring that samples are representative of field conditions by collecting and handling samples according to the approved site-specific SAP. Errors in sample collection, packaging, preservation, or COC procedures may result in samples being judged nonrepresentative and may form a basis for rejecting the data.

Data generated by the laboratory must be representative of the laboratory database of accuracy and precision measurements for analytes in different matrices. Laboratory procedures for sample preparation will ensure that aliquots used for analysis are representative of the whole sample.

37.2.4 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another, whether it was generated by a single laboratory or during inter-laboratory studies. The use of standardized field and analytical procedures ensures comparability of analytical data.

Sample collection and handling procedures will adhere to EPA-approved protocols. Laboratory procedures will follow standard analytical protocols, use standard units and standardized report formats, follow the calculations as referenced in the approved analytical methods, and use a standard statistical approach for QC measurements.

37.2.5 Completeness

Completeness is a measure of whether the data necessary to meet the project have been collected. For the data to be considered complete, they must meet acceptance criteria including accuracy and precision and other criteria specified for an analytical method. The data will be reviewed and/or validated to keep invalid data from being processed through data collection.

Completeness is evaluated using the following equation:

$$Completeness = \frac{Acceptable\ Results\ x\ 100\%}{Total\ Results}$$

The goal for completeness for QC parameters, except holding times, will be 90 percent. The goal for holding times will be 100 percent. If these goals are not achieved, the sources of nonconformances will be evaluated to determine whether resampling and reanalysis is necessary.

37.3 Sensitivity

Sensitivity is the capability of a method or instrument to measure target analyte responses. Sensitivity determines the minimum concentration or attribute that can be measured by a method

(method detection limit [DL]), by an instrument (instrument DL), or by a laboratory (LOD). The laboratory DLC, LOD, or DL will be sensitive enough to meet the project decision limits. Sensitivity may be affected by sample matrix factors such as interference of non-target analytes, sample materials, or sample dilution.

The DLC will be evaluated by the project team prior to sample analysis to determine if the laboratory is able to attain the required sensitivity for the project. The DLC will be evaluated after sample analysis to determine if there were any matrix effects, operator errors, or analytical process errors that interfered with the ability to compare the results to the project decision limits. The DLC will be used to determine if no detectable amounts of contaminants of concern are present. If no detectable amounts are reported and data are acceptable from the verification and validation, then the data are usable. If detectable amounts are reported and the verification and validation are acceptable, then the data are usable. If anomalies in sensitivity are present, the rationale for use or non-use of the affected samples will be discussed in the DQA report.

References

Aptim Federal Services, LLC, 2017a, *Radiation Protection Plan, Radiological Work Tasks, Remedial Action and Maintenance of Remedies at Hunters Point Naval Shipyard, San Francisco, California*.

Aptim Federal Services, LLC, 2017b, *APTIM Management System*.

ERS-Joint Venture, 2012, *Final Removal Action Completion Summary Report, Pier Radiological Surveys and Removal, Hunters Point Naval Shipyard, San Francisco, California*, August 2.

American Nuclear Society, *2012, ANSI/ANS-41.5-2012: Verification and Validation of Radiological Data for Use in Waste Management and Environmental Remediation.*

Naval Facilities Engineering Command Southwest (NAVFAC SW), 2001, *Environmental Work Instruction 3EN2.1—Chemical Data Validation*.

NAVFAC SW, 2005, *Environmental Work Instruction EVR.6—Environmental Data Management and Required Electronic Delivery Standards*.

NAVFAC SW, 2007, *Environmental Work Instruction EVR.4—Implementing and Maintaining the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Administrative Record and Compendium at NAVFAC Southwest*.

NAVFAC SW, 2011, *Environmental Work Instruction EVR.2—Review, Approval, Revision, and Amendment of Sampling and Analysis Plans*.

Naval Sea Systems Command, 2004, *Final Historical Radiological Assessment, Volume II, Use of General Radioactive Materials, 1939-2003*, August 31.

U.S. Department of Defense, 2017, *Quality System Manual for Environmental Laboratories, Version 5.1*.

U.S. Department of the Navy, 2006, *Final Base-wide Radiological Removal Action, Action Memorandum - Revision 2006, Hunters Point Shipyard, San Francisco, California.*

U.S. Department of the Navy, 2015, *Final Survey Unit Project Reports Abstract for Parcel C Sanitary Sewer and Storm Drain Removal Containing Naturally Occurring Radioactive Material (NORM) Fill Material Conducted after March 1, 2013*, May.

U.S. Environmental Protection Agency (EPA), 2001, *EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5, Office of Environmental Information*, EPA/240/B-01/003, Final, Washington, D.C., March.

EPA, 2005, *Uniform Federal Policy for Quality Assurance Project Plans, Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs, Intergovernmental Data Quality Task Force*, EPA-505-B-04-900A, DTIC ADA 427785, Final, Version 1, March.

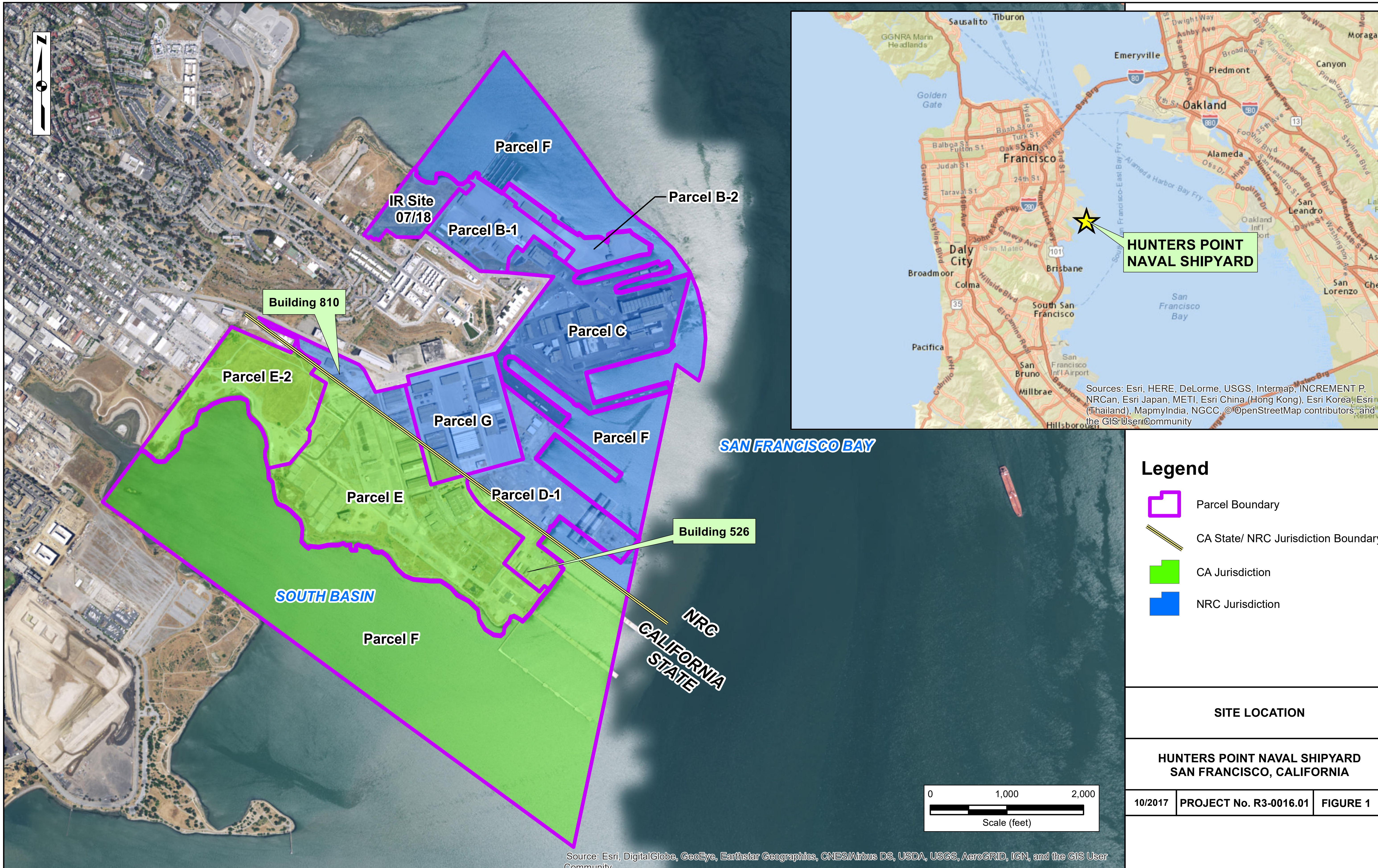
EPA, 2006, *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, Office of Environmental Information, EPA/240/B-06/001, Washington, D.C., February.

EPA, 2014, *National Functional Guidelines for Inorganic Superfund Data Review*, EPA 540-R-013-001, OSWER 9355.0-131, August.

U.S. Environmental Protection Agency, U.S. Department of Defense, U.S. Department of Energy, U.S. Department of Homeland Security, U.S. Nuclear Regulatory Agency, 2004, *Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP)*, NUREG-1576, EPA 402-B-04-001A, NTIS PB2004-105421, July.

U.S. Nuclear Regulatory Commission, U.S. Environmental Protection Agency, and U.S. Department of Energy, 2000, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, NUREG-1575, EPA 402-R-97-016, DOE/EH-0624, Revision 1, Washington, D.C.

FIGURES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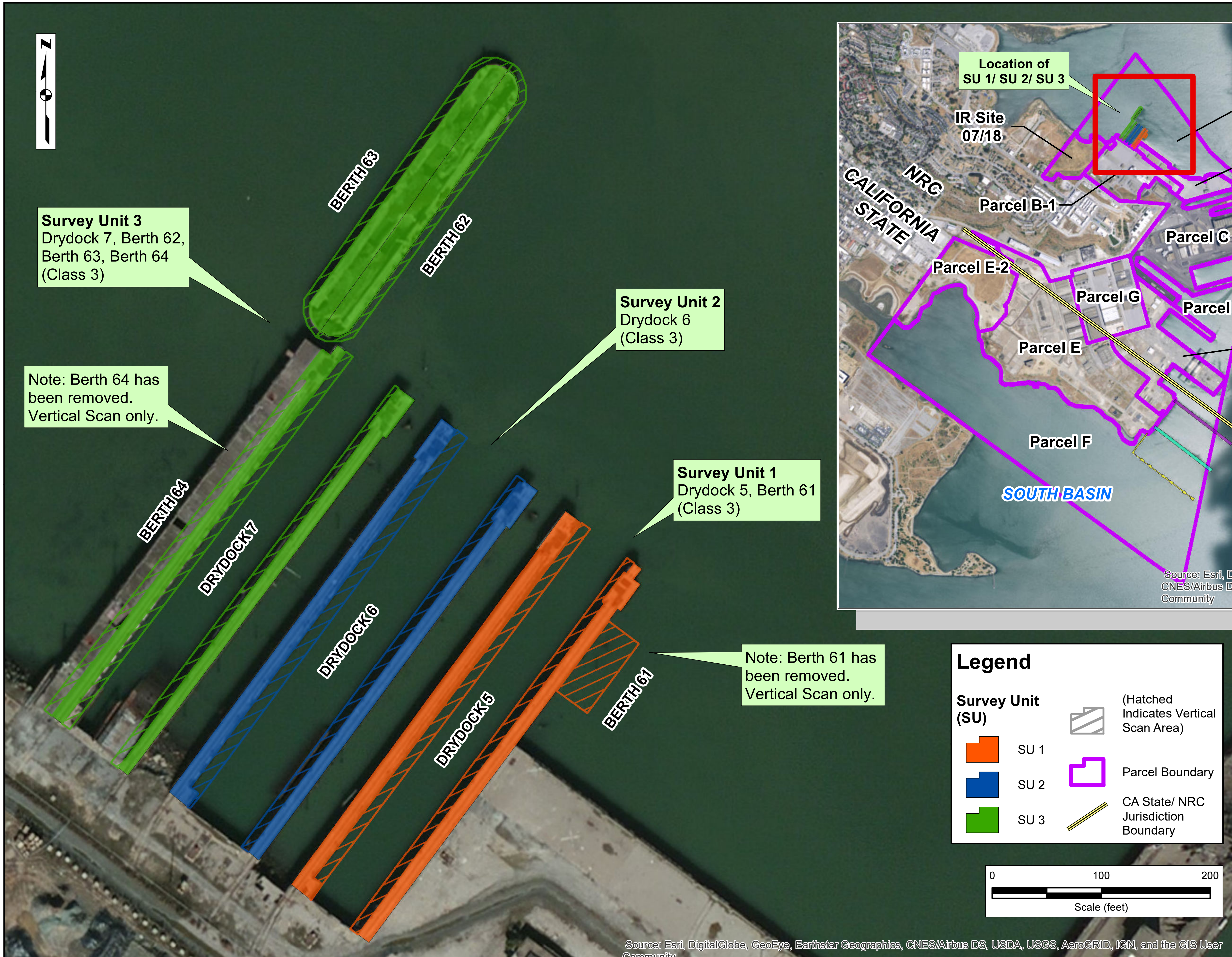
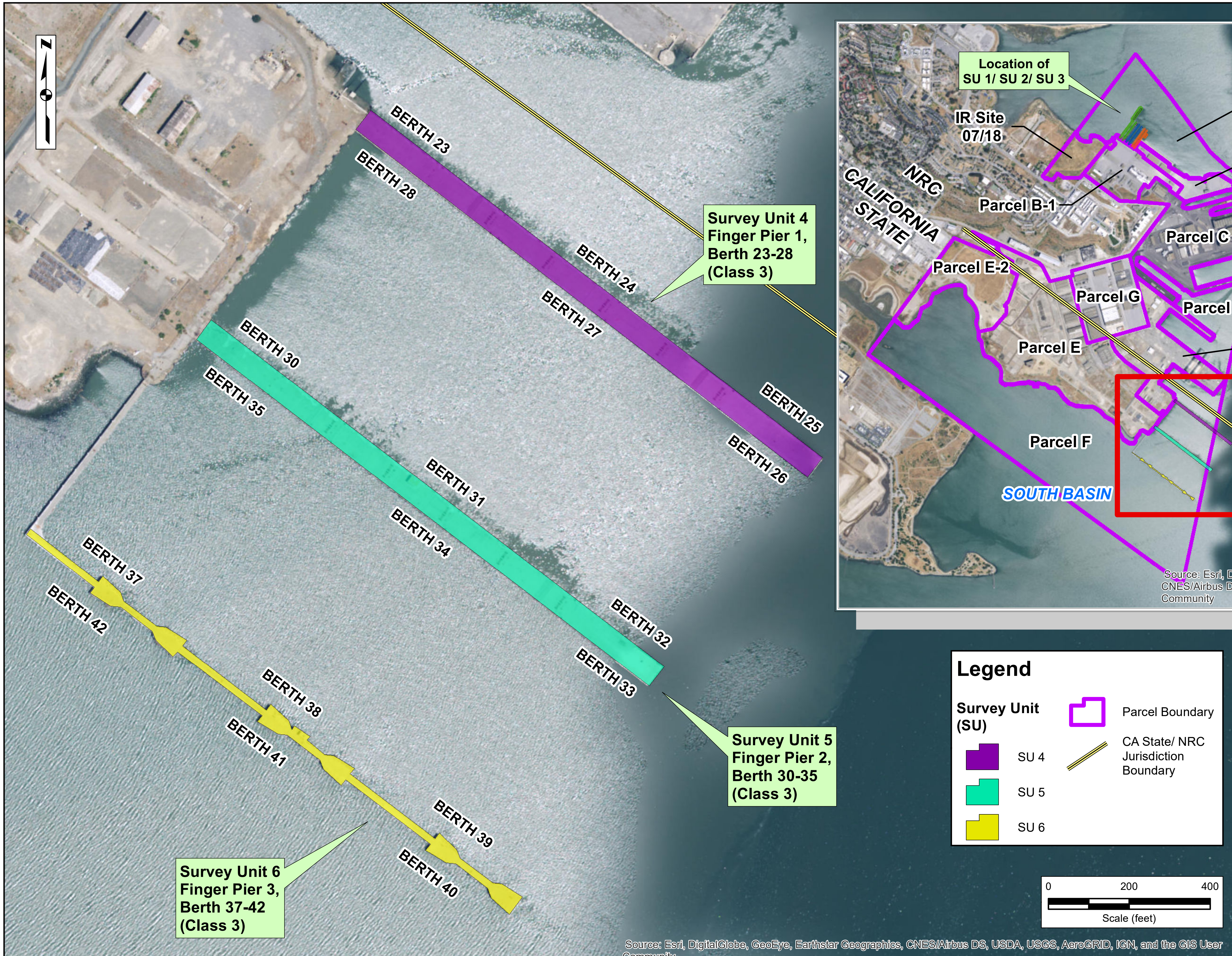
IR Site 07/18
Parcel B-1
Parcel B-2
Parcel C
Parcel G
Parcel F
Building 810
Parcel E-2
Parcel E
Parcel D-1
Building 526
SOUTH BASIN
Parcel F
NRC
CALIFORNIA STATE
SAN FRANCISCO BAY
HUNTERS POINT NAVAL SHIPYARD
Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community
Legend
Parcel Boundary
CA State/ NRC Jurisdiction Boundary
CA Jurisdiction
NRC Jurisdiction
0 1,000 2,000
Scale (feet)
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
SITE LOCATION
HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA
10/2017
PROJECT No. R3-0016.01
FIGURE 1



SURVEY UNITS (SU)
1, 2 & 3

HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

10/2017	PROJECT No. R3-0016.01	FIGURE 2



SURVEY UNITS (SU)
4, 5 & 6

HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

10/2017	PROJECT No. R3-0016.01	FIGURE 3

Attachment 1
Field Forms

CHAIN OF CUSTODY

APTIM

Ref. Document # 501008-001

Page 1 of 1

APTIM Federal Services, LLC
4005 Port Chicago Hwy
Concord, CA 94520

Project Number: 501008
Project Name: Hunters Point Naval Shipyard - Parcel F
Project Location:
Purchase Order #:
Shipment/Pickup Date:
Waybill Number:
Lab Destination: TestAmerica (St. Louis Lab)
13715 Rider Trail North
Earth City, MO 63045
Lab Contact Name / ph. #: Rhonda Ridenhower (314) 298-8566

Project Manager:
(Name & phone #)

Send Report To:
Phone/Fax Number:
Address:
City:
Sampler's Name(s):

Analyses Requested

Sample ID Number	Sample Description	Date	Time	Method	Matrix	# of containers		Gamma Spec (EPA 191.1 M) – (7 day in-growth preliminary results and full 21 day in growth for full gamma results)	Total Strontium (EPA 905 MOD)		Strontium 90 (EPA 905 MOD)			Dose Rate μR/Hr	
		Collection Information					Preservative (water)								
							Preservative (soil)	N/A	N/A		N/A				
							Container Type								
				G	SO	1	16 oz. plastic jar	X	X		X				
				G	SO	1	16 oz. plastic jar	X							
				G	SO	1	16 oz. plastic jar	X							
				G	SO	1	16 oz. plastic jar	X							
				G	SO	1	16 oz. plastic jar	X							
				G	SO	1	16 oz. plastic jar	X							
				G	SO	1	16 oz. plastic jar	X							
				G	SO	1	16 oz. plastic jar	X							
				G	SO	1	16 oz. plastic jar	X							
				G	SO	1	16 oz. plastic jar	X							

Special Instructions:

7 days ingrown draft and follow with 21 days final.
Analyze for Total Strontium as a screening step, and isotopic Sr-90 only if Total Strontium is above project action limit of 0.331 pCi/g.

Standard TAT -10-day ☐ 24-hr ☐ 3-day ☐ 10-day

Level Of QC Required: I II **III** Project Specific:

Relinquished By:	Date: / Time:	Received By:	Date: / Time:
Relinquished By:	Date: / Time:	Received By:	Date: / Time:
Relinquished By:	Date: / Time:	Received By:	Date: / Time:
Relinquished By:	Date: / Time:	Received By:	Date: / Time:

Method Codes C = Composite G = Grab

Matrix Codes
DW = Drinking Water SO =Soil
GW = Ground Water SL = Sludge
WW = Waste Water CP = Chip Samples
A = Air ABS=Asbestos, PO=Pipe Openning

DATE			
TIME	:		
PAGE	OF		
PROJECT NO.	**501008**		

APTIM

Aptim Federal Services LLC

SAMPLE COLLECTION LOG

PROJECT NAME **HPNS Parcel F**

SAMPLE NO. ____________________

SAMPLE LOCATION ____________________

SAMPLE TYPE ☐ Soil ☐ Water ☐ Air ☐ Other (give description)

COMPOSITE ☐ YES ☐ NO

COMPOSITE TYPE ____________________

DEPTH OF SAMPLE ____________________

WEATHER ____________________

MAP ON PAGE ☐

ANALYSES		CONTAINER AND AMOUNT COLLECTED
☐ PCBs	☐ PAHs	☐ 8 - OZ JARS
☐ Metals	☐ Sr90	☐ 4 - OZ JARS
☐ TPH	☐ Dioxin	☐ Encore
☐ Gamma Spec		☐ 16 - OZ JARS

COMMENTS:

PREPARED BY: ____________________

Attachment 2
Certifications and
Analytical Standard Operating Procedures

WORK INSTRUCTION

Work Instruction Title:	Radiation Detection Instrumentation	AMS Number:	AMS-710-07-WI-04014
Work Instruction Owner:	Federal Services HSE	Issuing Authority:	APTIM Quality Management

RADIATION DETECTION INSTRUMENTATION

INT	Issued for Interim Use	M. Hadacek & S. Lachney	7/30/2017
Rev	**Changes**	**Approved**	**Date**

1.0 PURPOSE

This work instruction provides the minimum requirements of the APTIM *Radiation Safety Program* (AMS-710-07-PR-04000) element "Radiation Detection Instrumentation". The principles, concepts, and requirements in this program document are to be used, as appropriate and necessary, to develop practices and work plans at work sites that receive, possess, use, transfer, or dispose of radioactive materials or sources of ionizing radiation that are governed by regulation.

2.0 APPLICATION

The work instruction is to be followed when developing a task- or site- specific Radiation Protection Plan (RPP) intended to support sites involving the potential for exposure to sources of occupational ionizing radiation.

3.0 REQUIREMENTS

The following personnel have responsibilities in this work instruction:

- Project/Program Radiation Safety Officer (PRSO)
- Director, Radiation Safety (DRS)

4.0 REFERENCES

ANSI N323A-1997	American National Standard Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments. American National Standards Institute. Published by the Institute of Electrical and Electronics Engineers, Inc. New York, New York.
AMS-710-07-PR-04000	Radiation Safety Program
DOE	Occupational Radiation Protection. U.S. Department of Energy, Title 10 Code of Federal Regulations, Part 835, Subpart E, 835.401 – 835.405, Subpart F, 835.501 - 835.502, Subpart G, 835.601 – 835.606, Subpart L, 835.1101 – 835.1102, and Appendix E. Washington, D.C.
DOE	Radiation Protection Programs Guide. DOE G 441.1-1C. U.S. Department of Energy, Washington, D.C.
NRC	Standards for Protection Against Radiation. U.S. Nuclear Regulatory Commission, Title 10 Code of Federal Regulations, Part 20, 1004, and Subpart F, 20.1501 – 20.1502
Technical Report	Abelquist, E. W., W. S. Brown, G. F. Powers, A. M. Huffert. 1998. Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions. U.S. Nuclear Regulatory Commission NUREG-1507. Washington, D.C.
Technical Report	Manufacturer's Instrument Technical and Users Manuals and Technical Reports

5.0 WORK INSTRUCTION

In accordance with APTIM *Radiation Safety Program* (AMS-710-07-PR-04000) the RPP shall document which radiation detection instruments are suitable for the required survey measurements. The PRSO shall develop and document a technical basis for verifying that the instruments used are appropriate for the radionuclides of concern and have sufficient sensitivity for the required measurements and monitoring for review and approval by the DRS. The information may be included or referenced in the task- or site-specific RPP.

Operating instructions and calibration and quality assurance procedures shall be maintained for each instrument and should be consistent with ANSI N323A. These requirements apply to both portable and fixed instruments.

5.1 Responsibilities

5.1.1 Project/Program Radiation Safety Officer (PRSO):

5.1.1.1 Periodically reviews the site procedure(s) for applicability and efficacy at least annually or when changing radiological conditions, instruments, project objectives, quality assurance/quality control (QA/QC) requirements, license, or regulatory changes warrant.

5.1.1.2 Establishes project and/or site-specific requirements for radiological survey and fixed instruments including the selection of parameters to be measured and specific instrumentation to be used.

5.1.1.3 Ensures that instrument surveys performed for the demonstration of compliance conform to the requirements of the RPP and applicable regulations.

5.1.1.4 Maintains an adequate inventory of functional, calibrated instruments including support equipment e.g., planchets, tools, and check sources.

5.1.1.5 Controls the use, storage and operation of all portable and fixed instruments.

5.1.1.6 Ensures that the calibration and operational checks of portable and fixed instruments are properly documented and conform to the requirements of this work instruction.

5.1.2 Director, Radiation Safety (DRS)

The DRS shall review and approve technical basis decisions addressing instrument sensitivity to detect the nuclides present at a fraction of the control levels.

5.2 Prerequisites

- Only personnel with appropriate, documented training shall issue or use radiation protection instruments. Training and documentation shall comply with 10 CFR 20.19 for NRC licensees and 10 CFR 835.103 and DOE G 441.1-1C for DOE Projects. Activities conducted under agreement state regulation shall have training compliant with those regulations. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites shall have training programs equivalent to those required by the appropriate regulatory group.
- Instruments and detectors shall be inspected for mechanical damage and shall be response tested prior to use.
- Instruments with mechanical damage or that do not pass the response test shall be removed from service and immediately tagged with a *Do Not Use* tag.
- Labels denoting current calibration shall be affixed to instruments in use.

5.3 Precautions and Limitation

- As Low as Reasonably Achievable (ALARA) practices shall be observed to minimize personnel exposure and the spread of contamination when using radiation protection instrumentation.
- Instruments removed from service for calibration, repair, or failure of a response test shall be physically segregated as practical from those instruments available for issue and shall be tagged or labelled to indicate their status.

- Portable survey instruments are susceptible to damage from physical and environmental stresses. Project procedures shall specify the environmental limits (e.g., temperature, humidity, etc.) for each instrument as specified by the manufacturer, if restrictive.
- Instruments will have been surveyed for contamination and decontaminated as necessary, prior to returning to the issue location.
- QA/QC requirements shall be established to include applicable calibration, daily response, and general operations acceptance criteria.
- Inspections, establishing acceptable ranges and daily performance checks shall only be performed by individuals trained and successfully tested on these tasks.

5.4 Characteristics, Accountability, Maintenance, and Calibration of Radiation Detection Instrumentation

5.4.1 Operating Characteristics

The PRSO shall ensure instrumentation is appropriate for the detection of the radionuclides of interest, including energy response, and that the expected Minimal Detectable Activity (MDA's) will meet project requirements. Operational characteristics should be verified with source testing once the instrumentation has been received and the results documented in a technical basis document. Any environmental limitations or special use conditions should be specified along with the required actions if those conditions are exceeded.

5.4.2 Receipt of Radiation Protection Instrumentation

Site-specific instrument procedure(s) shall define the requirements for placing radiation protection instruments in service in accordance with recommendations in Section 9.2.1 of ANSI N323A-1997 (ANSI, 1997).

The instrument may be used for 'information only', until:

- The required procedures have been written, reviewed, and approved.
- The calibration requirements have been satisfied.
- Successful passing of the general operations and source test in accordance with ANSI N323A-1997 (ANSI, 1997).

5.4.3 Performance Testing for Portable and Fixed Instruments

Site-specific instrument procedure(s) shall address the performance testing requirements before initial use, after maintenance that could affect performance, and periodically over the life of the Project to verify that they continue to meet the Project and or Site Measurement Quality Objectives. The site-specific instrument procedure(s) shall define the requirements for the testing and calibration of instruments. The testing and calibration of instruments should be performed under a group of controlled conditions called standard test conditions as described in Table 1 and Section 3.3 of ANSI N323A-1997 (ANSI, 1997).

5.4.4 Instrument Control and Accountability for Portable and Fixed Instruments

Site-specific instrument procedure(s) shall address the instrument accountability requirements including short-term and long-term use as appropriate, physical inventories by serial number, documentation and record keeping, and record disposition. Instrument issue and use should be limited to qualified personnel within the specified use parameters, including proper pre- and post-use checks, and required recordkeeping.

5.4.5 Maintenance for Portable and Fixed Instruments

Maintenance should be performed in accordance with the manufacturer's recommendations and preferably by the manufacturer. Recalibration shall be required following maintenance.

5.4.6 Pre-Calibration for Portable and Fixed Instruments

Instruments must be properly set-up, either at the work site or by the calibration service, in accordance with the instruction manuals prior to calibration. Set-up includes proper adjustment of high voltage, window settings, response time, battery checks, instrument zero, counting gas flow rate, and recording "as found" readings for the instrument. If the meter and detector are maintained as a set, ensure the proper detector is paired with the meter and that the cable is of the proper length. Check instruments for contamination and physical damage as well.

5.4.7 Calibration for Portable and Fixed Instruments

The PRSO shall ensure that the calibration frequency has been established for all instruments. Calibrations shall be performed using NIST traceable sources of the appropriate energy, source strength, and size for the intended use of the instrument. Source jigs shall be used to establish reproducible calibration geometries. Instrument scales to be calibrated shall be specified including whether at the low end, midpoint, or high end of the scale and the acceptance criteria. Specify the calibration data that must be recorded including as left conditions and alarm set points as appropriate. MDAs should be determined following calibration in accordance with NUREG-1507 (NRC, 1999).

5.4.8 Recordkeeping for Portable and Fixed Instruments

Accurate and complete records of instrument inventories, calibrations, repair history, and performance checks must be maintained. Information required on calibration labels must be specified.

5.4.9 Fixed Counting System General Requirements

The requirements for fixed counting systems are the same as described above and include the following requirements as well:

- Physical inspections.
- Counting gas requirements if appropriate.
- System set-up parameters.
- Range for background.
- Operational parameters.
- Performance testing and acceptable testing criteria.
- Appropriate response when instrument response is out of range.
- Sample counting operations, establishing required MDAs or Minimum Detectable Contamination (MDC's).
- Safety precautions.
- Record keeping requirements including data package and data verification and validation.

6.0 TERMINOLOGY

Term (Acronym)	***Definition***
ALARA	As Low As Reasonably Achievable
CERCLA	Comprehensive Environmental Response, Compensation, and

Term (Acronym)	***Definition***
	Liability Act
CFR	Code of Federal Regulations
DOE	Department of Energy
DRS	Director, Radiation Safety
MDA	Minimal Detectable Activity
MDC	Minimum Detectable Contamination
NIST	National Institute of Standards and Technology, the national organization for establishing the quality standards for radiation sources used for instrument calibration.
PRSO	Project Radiation Safety Officer
QA/QC	Quality Assurance/Quality Control
RPP	Radiation Protection Plan

7.0 EXHIBITS

Exhibit 7.1 AMS-720-01-FM-00020 – Business Glossary

Exhibit 7.2 AMS-720-01-FM-00021 – Technical Glossary

CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

CALIFORNIA STATE

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

CERTIFICATE OF ENVIRONMENTAL ACCREDITATION

Is hereby granted to

TestAmerica St. Louis

13715 Rider Trail North

Earth City, MO 63045

Scope of the certificate is limited to the
"Fields of Testing"
which accompany this Certificate.

Continued accredited status depends on successful completion of on-site inspection, proficiency testing studies, and payment of applicable fees.

This Certificate is granted in accordance with provisions of Section 100825, et seq. of the Health and Safety Code.

Certificate No.: **2886**

Expiration Date: **3/31/2018**

Effective Date: **4/1/2016**

Sacramento, California
subject to forfeiture or revocation

Christine Sotelo, Chief
Environmental Laboratory Accreditation Program

CALIFORNIA Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

CALIFORNIA STATE
ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM
Accredited Fields of Testing

TestAmerica St. Louis

13715 Rider Trail North
Earth City, MO 63045
Phone: (314) 298-8566

Certificate No. **2886**
Expiration Date **3/31/2018**

Field of Testing: 106 - Radiochemistry of Drinking Water

106.010	001	Gross Alpha and Beta Radiation	EPA 900.0
106.010	002	Gross Beta	EPA 900.0
106.030	003	Gamma Emitters	EPA 901.1
106.050	002	Radium-226 (estimate)	EPA 903.0
106.060	001	Radium-228	EPA 904.0
106.070	003	Strontium-90	EPA 905.0
106.080	001	Tritium	EPA 906.0
106.220	001	Strontium-89, 90	DOE Sr-02

Field of Testing: 108 - Inorganic Chemistry of Wastewater

108.020	001	Conductivity	EPA 120.1
108.112	001	Boron	EPA 200.7
108.112	002	Calcium	EPA 200.7
108.112	004	Magnesium	EPA 200.7
108.112	005	Potassium	EPA 200.7
108.112	007	Sodium	EPA 200.7
108.113	003	Magnesium	EPA 200.8
108.120	001	Bromide	EPA 300.0
108.120	002	Chloride	EPA 300.0
108.120	003	Fluoride	EPA 300.0
108.120	012	Nitrate (as N)	EPA 300.0
108.120	014	Nitrite (as N)	EPA 300.0
108.120	015	Phosphate, Ortho (as P)	EPA 300.0
108.183	001	Cyanide, Total	EPA 335.4
108.211	002	Kjeldahl Nitrogen, Total (as N)	EPA 351.2
108.323	001	Chemical Oxygen Demand	EPA 410.4
108.381	001	Oil and Grease	EPA 1664A
108.440	001	Residue, Total	SM2540B-1997
108.441	001	Residue, Filterable TDS	SM2540C-1997
108.442	001	Residue, Non-filterable TSS	SM2540D-1997
108.490	001	Hydrogen Ion (pH)	SM4500-H+ B-2000

Field of Testing: 109 - Toxic Chemical Elements of Wastewater

109.010	001	Aluminum	EPA 200.7
109.010	002	Antimony	EPA 200.7
109.010	003	Arsenic	EPA 200.7
109.010	004	Barium	EPA 200.7
109.010	005	Beryllium	EPA 200.7
109.010	006	Boron	EPA 200.7

109.010	007	Cadmium	EPA 200.7
109.010	009	Chromium	EPA 200.7
109.010	010	Cobalt	EPA 200.7
109.010	011	Copper	EPA 200.7
109.010	012	Iron	EPA 200.7
109.010	013	Lead	EPA 200.7
109.010	015	Manganese	EPA 200.7
109.010	016	Molybdenum	EPA 200.7
109.010	017	Nickel	EPA 200.7
109.010	019	Selenium	EPA 200.7
109.010	021	Silver	EPA 200.7
109.010	023	Thallium	EPA 200.7
109.010	024	Tin	EPA 200.7
109.010	025	Titanium	EPA 200.7
109.010	026	Vanadium	EPA 200.7
109.010	027	Zinc	EPA 200.7
109.020	001	Aluminum	EPA 200.8
109.020	002	Antimony	EPA 200.8
109.020	003	Arsenic	EPA 200.8
109.020	004	Barium	EPA 200.8
109.020	005	Beryllium	EPA 200.8
109.020	006	Cadmium	EPA 200.8
109.020	007	Chromium	EPA 200.8
109.020	008	Cobalt	EPA 200.8
109.020	009	Copper	EPA 200.8
109.020	010	Lead	EPA 200.8
109.020	011	Manganese	EPA 200.8
109.020	012	Molybdenum	EPA 200.8
109.020	013	Nickel	EPA 200.8
109.020	014	Selenium	EPA 200.8
109.020	015	Silver	EPA 200.8
109.020	016	Thallium	EPA 200.8
109.020	017	Vanadium	EPA 200.8
109.020	018	Zinc	EPA 200.8
109.190	001	Mercury	EPA 245.1
Field of Testing: 110 - Volatile Organic Chemistry of Wastewater			
110.040	000	Purgeable Organic Compounds	EPA 624
Field of Testing: 111 - Semi-volatile Organic Chemistry of Wastewater			
111.100	000	Base/Neutral & Acid Organics	EPA 625
111.170	000	Organochlorine Pesticides and PCBs	EPA 608
Field of Testing: 112 - Radiochemistry of Wastewater			
112.010	001	Gross Alpha and Beta Radiation	EPA 900.0
112.010	002	Gross Beta	EPA 900.0
112.020	001	Total Alpha Radium	EPA 903.0
112.140	002	Gamma	EPA 901.1
112.160	001	Radium-228	EPA 904.0

112.170	001	Strontium	EPA 905.0
112.180	001	Tritium	EPA 906.0
112.510	001	Strontium	DOE Sr-02

Field of Testing: 114 - Inorganic Chemistry of Hazardous Waste

114.010	001	Antimony	EPA 6010B
114.010	002	Arsenic	EPA 6010B
114.010	003	Barium	EPA 6010B
114.010	004	Beryllium	EPA 6010B
114.010	005	Cadmium	EPA 6010B
114.010	006	Chromium	EPA 6010B
114.010	007	Cobalt	EPA 6010B
114.010	008	Copper	EPA 6010B
114.010	009	Lead	EPA 6010B
114.010	010	Molybdenum	EPA 6010B
114.010	011	Nickel	EPA 6010B
114.010	012	Selenium	EPA 6010B
114.010	013	Silver	EPA 6010B
114.010	014	Thallium	EPA 6010B
114.010	015	Vanadium	EPA 6010B
114.010	016	Zinc	EPA 6010B
114.020	001	Antimony	EPA 6020
114.020	002	Arsenic	EPA 6020
114.020	003	Barium	EPA 6020
114.020	004	Beryllium	EPA 6020
114.020	005	Cadmium	EPA 6020
114.020	006	Chromium	EPA 6020
114.020	007	Cobalt	EPA 6020
114.020	008	Copper	EPA 6020
114.020	009	Lead	EPA 6020
114.020	010	Molybdenum	EPA 6020
114.020	011	Nickel	EPA 6020
114.020	012	Selenium	EPA 6020
114.020	013	Silver	EPA 6020
114.020	014	Thallium	EPA 6020
114.020	015	Vanadium	EPA 6020
114.020	016	Zinc	EPA 6020
114.103	001	Chromium (VI)	EPA 7196A
114.141	001	Mercury	EPA 7471A
114.221	001	Cyanide, Total	EPA 9012A
114.241	001	Corrosivity - pH Determination	EPA 9045C
114.250	001	Fluoride	EPA 9056

Field of Testing: 115 - Extraction Test of Hazardous Waste

115.020	001	Toxicity Characteristic Leaching Procedure (TCLP)	EPA 1311
115.021	001	TCLP Inorganics	EPA 1311
115.022	001	TCLP Extractables	EPA 1311
115.023	001	TCLP Volatiles	EPA 1311

115.030	001	Waste Extraction Test (WET)	CCR Chapter11, Article 5, Appendix II
115.040	001	Synthetic Precipitation Leaching Procedure (SPLP)	EPA 1312

Field of Testing: 116 - Volatile Organic Chemistry of Hazardous Waste

116.030	001	Gasoline-range Organics	EPA 8015B
116.080	000	Volatile Organic Compounds	EPA 8260B

Field of Testing: 117 - Semi-volatile Organic Chemistry of Hazardous Waste

117.010	001	Diesel-range Total Petroleum Hydrocarbons	EPA 8015B
117.110	000	Extractable Organics	EPA 8270C
117.170	000	Nitroaromatics and Nitramines	EPA 8330
117.210	000	Organochlorine Pesticides	EPA 8081A
117.220	000	PCBs	EPA 8082
117.250	000	Chlorinated Herbicides	EPA 8151A

Field of Testing: 118 - Radiochemistry of Hazardous Waste

118.010	001	Gross Alpha and Beta In Hazardous Wastes	EPA 9310
118.010	002	Gross Beta	EPA 9310
118.020	001	Radium, Total	EPA 9315
118.030	001	Radium-228	EPA 9320
118.271	001	Strontium	DOE Sr-02

Field of Testing: 120 - Physical Properties of Hazardous Waste

120.010	001	Ignitability	EPA 1010
120.040	001	Reactive Cyanide	Section 7.3 SW-846
120.050	001	Reactive Sulfide	Section 7.3 SW-846
120.070	001	Corrosivity - pH Determination	EPA 9040B
120.080	001	Corrosivity - pH Determination	EPA 9045C

LABORATORY ACCREDITATION BUREAU a division of A-S-B

DoD ELAP

Certificate of Accreditation

ISO/IEC 17025:2005 Certificate Number L2305

TestAmerica Laboratories

St. Louis Facility
13715 Rider Trail North
Earth City Missouri 63045

has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation valid through: April 6, 2019

R. Douglas Leonard, Jr., President, COO
Laboratory Accreditation Bureau
Presented the 6th of April 2016

*See the laboratory's Scope of Accreditation for details of accredited parameters
**Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).
Form 403.14 – Rev 1 7/3/13

LABORATORY ACCREDITATION BUREAU

Certificate # L2305

Scope of Accreditation For TestAmerica Laboratories

St. Louis Facility
13715 Rider Trail North
Earth City, Missouri 63045
Tony Byrd
314-298-8566

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (LABPR 403 DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM V5) based on the TNI Standard - Environmental Laboratory Sector, Volume 1 – Management and Technical Requirements for Laboratories Performing Environmental Analysis, Sept 2009 (EL-V1-2009); accreditation is granted to **TestAmerica Laboratories** to perform the following tests:

Accreditation granted through: **April 6, 2019**

Testing - Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-AES	EPA 6010C	Aluminum
ICP-AES	EPA 6010C	Antimony
ICP-AES	EPA 6010C	Arsenic
ICP-AES	EPA 6010C	Barium
ICP-AES	EPA 6010C	Beryllium
ICP-AES	EPA 6010C	Bismuth
ICP-AES	EPA 6010C	Boron
ICP-AES	EPA 6010C	Cadmium
ICP-AES	EPA 6010C	Calcium
ICP-AES	EPA 6010C	Chromium
ICP-AES	EPA 6010C	Cobalt
ICP-AES	EPA 6010C	Copper
ICP-AES	EPA 6010C	Iron
ICP-AES	EPA 6010C	Lead
ICP-AES	EPA 6010C	Lithium
ICP-AES	EPA 6010C	Magnesium

Non-Potable Water

Technology	Method	Analyte
ICP-AES	EPA 6010C	Manganese
ICP-AES	EPA 6010C	Molybdenum
ICP-AES	EPA 6010C	Nickel
ICP-AES	EPA 6010C	Phosphorus
ICP-AES	EPA 6010C	Potassium
ICP-AES	EPA 6010C	Selenium
ICP-AES	EPA 6010C	Silicon
ICP-AES	EPA 6010C	Silver
ICP-AES	EPA 6010C	Sodium
ICP-AES	EPA 6010C	Strontium
ICP-AES	EPA 6010C	Sulfur
ICP-AES	EPA 6010C	Thallium
ICP-AES	EPA 6010C	Thorium
ICP-AES	EPA 6010C	Tin
ICP-AES	EPA 6010C	Titanium
ICP-AES	EPA 6010C	Uranium
ICP-AES	EPA 6010C	Vanadium
ICP-AES	EPA 6010C	Zinc
GC/MS	EPA 8260C	Acetone
GC/MS	EPA 8260C	Acetonitrile
GC/MS	EPA 8260C	Acrolein
GC/MS	EPA 8260C	Acrylonitrile
GC/MS	EPA 8260C	Benzene
GC/MS	EPA 8260C	Benzyl chloride
GC/MS	EPA 8260C	Bromobenzene
GC/MS	EPA 8260C	Bromochloromethane
GC/MS	EPA 8260C	Bromodichloromethane
GC/MS	EPA 8260C	Bromoform
GC/MS	EPA 8260C	Bromomethane
GC/MS	EPA 8260C	n-Butanol
GC/MS	EPA 8260C	2-Butanone
GC/MS	EPA 8260C	n-Butylbenzene
GC/MS	EPA 8260C	sec-Butylbenzene
GC/MS	EPA 8260C	tert-Butylbenzene
GC/MS	EPA 8260C	Carbon disulfide

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8260C	Carbon tetrachloride
GC/MS	EPA 8260C	Chlorobenzene
GC/MS	EPA 8260C	Chlorobromomethane
GC/MS	EPA 8260C	2-Chloro-1,3-butadiene
GC/MS	EPA 8260C	Chlorodibromomethane
GC/MS	EPA 8260C	Dibromochloromethane
GC/MS	EPA 8260C	Chloroethane
GC/MS	EPA 8260C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260C	Chloroform
GC/MS	EPA 8260C	Chloromethane
GC/MS	EPA 8260C	Allyl chloride
GC/MS	EPA 8260C	2-Chlorotoluene
GC/MS	EPA 8260C	4-Chlorotoluene
GC/MS	EPA 8260C	Cyclohexane
GC/MS	EPA 8260C	Cyclohexanone
GC/MS	EPA 8260C	1,2-Dibromo-3-chloropropane
GC/MS	EPA 8260C	1,2-Dibromoethane
GC/MS	EPA 8260C	Dibromomethane
GC/MS	EPA 8260C	1,2-Dichlorobenzene
GC/MS	EPA 8260C	1,3-Dichlorobenzene
GC/MS	EPA 8260C	1,4-Dichlorobenzene
GC/MS	EPA 8260C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260C	Dichlorodifluoromethane
GC/MS	EPA 8260C	1,1-Dichloroethane
GC/MS	EPA 8260C	1,2-Dichloroethane
GC/MS	EPA 8260C	cis-1,2-Dichloroethene
GC/MS	EPA 8260C	trans-1,2-Dichloroethene
GC/MS	EPA 8260C	1,1-Dichloroethene
GC/MS	EPA 8260C	1,2-Dichloroethene (total)
GC/MS	EPA 8260C	1,2-Dichloropropane
GC/MS	EPA 8260C	1,3-Dichloropropane
GC/MS	EPA 8260C	2,2-Dichloropropane
GC/MS	EPA 8260C	cis-1,3-Dichloropropene
GC/MS	EPA 8260C	trans-1,3-Dichloropropene
GC/MS	EPA 8260C	1,1-Dichloropropene

LABORATORY ACCREDITATION BUREAU

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	1,2-Dichloro-1,1,2,2-tetrafluoroethane
GC/MS	EPA 8260C	Dimethyl disulfide
GC/MS	EPA 8260C	1,4-Dioxane
GC/MS	EPA 8260C	Ethyl acetate
GC/MS	EPA 8260C	Ethylbenzene
GC/MS	EPA 8260C	Ethyl ether
GC/MS	EPA 8260C	Diethyl ether
GC/MS	EPA 8260C	Ethyl methacrylate
GC/MS	EPA 8260C	Freon 113
GC/MS	EPA 8260C	Hexachlorobutadiene
GC/MS	EPA 8260C	n-Hexane
GC/MS	EPA 8260C	2-Hexanone
GC/MS	EPA 8260C	Iodomethane
GC/MS	EPA 8260C	Isobutanol
GC/MS	EPA 8260C	Isopropylbenzene
GC/MS	EPA 8260C	p-Isopropyltoluene
GC/MS	EPA 8260C	Methacrylonitrile
GC/MS	EPA 8260C	Methyl acetate
GC/MS	EPA 8260C	Methyl butyl ketone
GC/MS	EPA 8260C	Methylcyclohexane
GC/MS	EPA 8260C	Dichloromethane
GC/MS	EPA 8260C	Methylene chloride
GC/MS	EPA 8260C	Methyl methacrylate
GC/MS	EPA 8260C	4-Methyl-2-pentanone
GC/MS	EPA 8260C	MTBE
GC/MS	EPA 8260C	Naphthalene
GC/MS	EPA 8260C	2-Nitropropane
GC/MS	EPA 8260C	Nonanal
GC/MS	EPA 8260C	Pentachloroethane
GC/MS	EPA 8260C	Propionitrile
GC/MS	EPA 8260C	n-Propylbenzene
GC/MS	EPA 8260C	Styrene
GC/MS	EPA 8260C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260C	Tetrachloroethene

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8260C	Tetrahydrofuran
GC/MS	EPA 8260C	Toluene
GC/MS	EPA 8260C	1,3,5-Trichlorobenzene
GC/MS	EPA 8260C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260C	1,2,4-Trichlorobenzene
GC/MS	EPA 8260C	1,1,1-Trichloroethane
GC/MS	EPA 8260C	1,1,2-Trichloroethane
GC/MS	EPA 8260C	Trichloroethene
GC/MS	EPA 8260C	Trichlorofluoromethane
GC/MS	EPA 8260C	1,2,3-Trichloropropane
GC/MS	EPA 8260C	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 8260C	Trichlorotrifluoroethane
GC/MS	EPA 8260C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260C	1,3,5-Trimethylbenzene
GC/MS	EPA 8260C	Vinyl acetate
GC/MS	EPA 8260C	Vinyl chloride
GC/MS	EPA 8260C	m-Xylene & p-Xylene
GC/MS	EPA 8260C	o-Xylene
GC/MS	EPA 8260C	Xylenes (total)
GC/MS	EPA 8260C SIM	1,4-Dioxane
GC/MS	EPA 624	Acetone
GC/MS	EPA 624	Acetonitrile
GC/MS	EPA 624	Acrolein
GC/MS	EPA 624	Acrylonitrile
GC/MS	EPA 624	Benzene
GC/MS	EPA 624	Benzyl chloride
GC/MS	EPA 624	Bromobenzene
GC/MS	EPA 624	Bromochloromethane
GC/MS	EPA 624	Bromodichloromethane
GC/MS	EPA 624	Bromoform
GC/MS	EPA 624	Bromomethane
GC/MS	EPA 624	n-Butanol
GC/MS	EPA 624	2-Butanone
GC/MS	EPA 624	n-Butylbenzene
GC/MS	EPA 624	sec-Butylbenzene

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Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 624	tert-Butylbenzene
GC/MS	EPA 624	Carbon disulfide
GC/MS	EPA 624	Carbon tetrachloride
GC/MS	EPA 624	Chlorobenzene
GC/MS	EPA 624	Chlorobromomethane
GC/MS	EPA 624	2-Chloro-1,3-butadiene
GC/MS	EPA 624	Chlorodibromomethane
GC/MS	EPA 624	Dibromochloromethane
GC/MS	EPA 624	Chloroethane
GC/MS	EPA 624	2-Chloroethyl vinyl ether
GC/MS	EPA 624	Chloroform
GC/MS	EPA 624	Chloromethane
GC/MS	EPA 624	Allyl chloride
GC/MS	EPA 624	2-Chlorotoluene
GC/MS	EPA 624	4-Chlorotoluene
GC/MS	EPA 624	Cyclohexane
GC/MS	EPA 624	Cyclohexanone
GC/MS	EPA 624	1,2-Dibromo-3-chloropropane
GC/MS	EPA 624	1,2-Dibromoethane
GC/MS	EPA 624	Dibromomethane
GC/MS	EPA 624	1,2-Dichlorobenzene
GC/MS	EPA 624	1,3-Dichlorobenzene
GC/MS	EPA 624	1,4-Dichlorobenzene
GC/MS	EPA 624	trans-1,4-Dichloro-2-butene
GC/MS	EPA 624	Dichlorodifluoromethane
GC/MS	EPA 624	1,1-Dichloroethane
GC/MS	EPA 624	1,2-Dichloroethane
GC/MS	EPA 624	cis-1,2-Dichloroethene
GC/MS	EPA 624	trans-1,2-Dichloroethene
GC/MS	EPA 624	1,1-Dichloroethene
GC/MS	EPA 624	1,2-Dichloroethene (total)
GC/MS	EPA 624	1,2-Dichloropropane
GC/MS	EPA 624	1,3-Dichloropropane
GC/MS	EPA 624	2,2-Dichloropropane
GC/MS	EPA 624	cis-1,3-Dichloropropene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624	trans-1,3-Dichloropropene
GC/MS	EPA 624	1,1-Dichloropropene
GC/MS	EPA 624	1,2-Dichloro-1,1,2,2-tetrafluoroethane
GC/MS	EPA 624	Dimethyl disulfide
GC/MS	EPA 624	1,4-Dioxane
GC/MS	EPA 624	Ethyl acetate
GC/MS	EPA 624	Ethylbenzene
GC/MS	EPA 624	Ethyl ether
GC/MS	EPA 624	Diethyl ether
GC/MS	EPA 624	Ethyl methacrylate
GC/MS	EPA 624	Freon 113
GC/MS	EPA 624	Hexachlorobutadiene
GC/MS	EPA 624	n-Hexane
GC/MS	EPA 624	2-Hexanone
GC/MS	EPA 624	Iodomethane
GC/MS	EPA 624	Isobutanol
GC/MS	EPA 624	Isopropylbenzene
GC/MS	EPA 624	p-Isopropyltoluene
GC/MS	EPA 624	Methacrylonitrile
GC/MS	EPA 624	Methyl acetate
GC/MS	EPA 624	Methyl butyl ketone
GC/MS	EPA 624	Methylcyclohexane
GC/MS	EPA 624	Dichloromethane
GC/MS	EPA 624	Methylene chloride
GC/MS	EPA 624	Methyl methacrylate
GC/MS	EPA 624	4-Methyl-2-pentanone
GC/MS	EPA 624	MTBE
GC/MS	EPA 624	Naphthalene
GC/MS	EPA 624	2-Nitropropane
GC/MS	EPA 624	Nonanal
GC/MS	EPA 624	Pentachloroethane
GC/MS	EPA 624	Propionitrile
GC/MS	EPA 624	n-Propylbenzene
GC/MS	EPA 624	Styrene
GC/MS	EPA 624	1,1,1,2-Tetrachloroethane

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Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624	1,1,2,2-Tetrachloroethane
GC/MS	EPA 624	Tetrachloroethene
GC/MS	EPA 624	Tetrahydrofuran
GC/MS	EPA 624	Toluene
GC/MS	EPA 624	1,3,5-Trichlorobenzene
GC/MS	EPA 624	1,2,3-Trichlorobenzene
GC/MS	EPA 624	1,2,4-Trichlorobenzene
GC/MS	EPA 624	1,1,1-Trichloroethane
GC/MS	EPA 624	1,1,2-Trichloroethane
GC/MS	EPA 624	Trichloroethene
GC/MS	EPA 624	Trichlorofluoromethane
GC/MS	EPA 624	1,2,3-Trichloropropane
GC/MS	EPA 624	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 624	Trichlorotrifluoroethane
GC/MS	EPA 624	1,2,4-Trimethylbenzene
GC/MS	EPA 624	1,3,5-Trimethylbenzene
GC/MS	EPA 624	Vinyl acetate
GC/MS	EPA 624	Vinyl chloride
GC/MS	EPA 624	m-Xylene & p-Xylene
GC/MS	EPA 624	o-Xylene
GC/MS	EPA 624	Xylenes (total)
GC/MS	EPA 8270D	Acenaphthene
GC/MS	EPA 8270D	Acenaphthylene
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	2-Acetylaminofluorene
GC/MS	EPA 8270D	4-Aminobiphenyl
GC/MS	EPA 8270D	Aniline
GC/MS	EPA 8270D	Anthracene
GC/MS	EPA 8270D	Aramite (total)
GC/MS	EPA 8270D	Atrazine
GC/MS	EPA 8270D	Azobenzene
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D	Benzo(a)anthracene
GC/MS	EPA 8270D	Benzo(b)fluoranthene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Benzoic acid
GC/MS	EPA 8270D	Benzo(ghi)perylene
GC/MS	EPA 8270D	Benzo(a)pyrene
GC/MS	EPA 8270D	Benzyl alcohol
GC/MS	EPA 8270D	1,1'-Biphenyl
GC/MS	EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270D	bis(2-Chloroisopropyl) ether
GC/MS	EPA 8270D	bis(2-Ethylhexyl) phthalate
GC/MS	EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270D	n-Butylbenzenesulfonamide
GC/MS	EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	Chlorobenzilate
GC/MS	EPA 8270D	p-Chlorobenzilate
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	4-Chlorophenyl phenyl ether
GC/MS	EPA 8270D	Chrysene
GC/MS	EPA 8270D	Cresols (total)
GC/MS	EPA 8270D	Cyclohexanol
GC/MS	EPA 8270D	Diallate
GC/MS	EPA 8270D	Dibenz(a,h)anthracene
GC/MS	EPA 8270D	Dibenzo(a,h)anthracene
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 8270D	1,2-Dichlorobenzene
GC/MS	EPA 8270D	1,3-Dichlorobenzene
GC/MS	EPA 8270D	1,4-Dichlorobenzene
GC/MS	EPA 8270D	3,3'-Dichlorobenzidine
GC/MS	EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 8270D	2,6-Dichlorophenol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Diethyl phthalate
GC/MS	EPA 8270D	O,O-Diethyl-O-(2-pyrazinyl) phosphorothioate
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	p-Dimethylaminoazobenzene
GC/MS	EPA 8270D	7,12-Dimethylbenz(a)anthracene
GC/MS	EPA 8270D	3,3'-Dimethylbenzidine
GC/MS	EPA 8270D	Dimethylformamide
GC/MS	EPA 8270D	alpha,alpha-Dimethylphenethylamine
GC/MS	EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	1,3-Dinitrobenzene
GC/MS	EPA 8270D	1,4-Dinitrobenzene
GC/MS	EPA 8270D	4,6-Dinitro-2-methylphenol
GC/MS	EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 8270D	2,4-Dinitrotoluene
GC/MS	EPA 8270D	2,6-Dinitrotoluene
GC/MS	EPA 8270D	2-sec-Butyl-4,6-dinitrophenol
GC/MS	EPA 8270D	Dinoseb
GC/MS	EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 8270D	1,4-Dioxane
GC/MS	EPA 8270D	1,2-Diphenylhydrazine (as Azobenzene)
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Ethyl methacrylate
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Fluoranthene
GC/MS	EPA 8270D	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloro-1,3-cyclopentadiene
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Hexachlorophene
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 8270D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isodrin

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	Methapyrilene
GC/MS	EPA 8270D	2-Methylbenzenamine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 8270D	4,4'-Methylenebis(2-chloroaniline)
GC/MS	EPA 8270D	Methyl methacrylate
GC/MS	EPA 8270D	Methyl methanesulfonate
GC/MS	EPA 8270D	2-Methylnaphthalene
GC/MS	EPA 8270D	Methyl parathion
GC/MS	EPA 8270D	2-Methylphenol
GC/MS	EPA 8270D	3-Methylphenol & 4-Methylphenol
GC/MS	EPA 8270D	2-Methylphenol, 3-methylphenol and 4-methylphenol
GC/MS	EPA 8270D	Methylphenols (total)
GC/MS	EPA 8270D	Naphthalene
GC/MS	EPA 8270D	1,4-Naphthoquinone
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	4-Nitroquinoline-1-oxide
GC/MS	EPA 8270D	N-Nitrosodi-n-butylamine
GC/MS	EPA 8270D	N-Nitrosodiethylamine
GC/MS	EPA 8270D	N-Nitrosodimethylamine
GC/MS	EPA 8270D	N-Nitrosodiphenylamine
GC/MS	EPA 8270D	N-Nitrosodi-n-propylamine
GC/MS	EPA 8270D	N-Nitrosomethylethylamine
GC/MS	EPA 8270D	N-Nitrosomorpholine
GC/MS	EPA 8270D	N-Nitrosopiperidine
GC/MS	EPA 8270D	N-Nitrosopyrrolidine
GC/MS	EPA 8270D	5-Nitro-o-toluidine

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Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8270D	2,2'-oxybis(1-Chloropropane)
GC/MS	EPA 8270D	Parathion
GC/MS	EPA 8270D	Pentachlorobenzene
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Pentachloronitrobenzene
GC/MS	EPA 8270D	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 8270D	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	p-Phenylene diamine
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	2-Picoline
GC/MS	EPA 8270D	Pronamide
GC/MS	EPA 8270D	Pyrene
GC/MS	EPA 8270D	Pyridine
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	Sulfotepp
GC/MS	EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270D	Tetraethyldithiopyrophosphate (Sulfotepp)
GC/MS	EPA 8270D	Thionazin
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	Tributyl phosphate
GC/MS	EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 8270D	O,O,O-Triethyl phosphorothioate
GC/MS	EPA 8270D	1,3,5-Trinitrobenzene
GC/MS	EPA 8270D	Tris(2-chloroethyl)phosphate
GC/MS	EPA 8270D	1-Methyl naphthalene
GC/MS	EPA 625	Acenaphthene
GC/MS	EPA 625	Acenaphthylene
GC/MS	EPA 625	Acetophenone
GC/MS	EPA 625	2-Acetylaminofluorene
GC/MS	EPA 625	4-Aminobiphenyl
GC/MS	EPA 625	Aniline

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 625	Anthracene
GC/MS	EPA 625	Aramite (total)
GC/MS	EPA 625	Atrazine
GC/MS	EPA 625	Azobenzene
GC/MS	EPA 625	Benzaldehyde
GC/MS	EPA 625	Benzidine
GC/MS	EPA 625	Benzo(a)anthracene
GC/MS	EPA 625	Benzo(b)fluoranthene
GC/MS	EPA 625	Benzo(k)fluoranthene
GC/MS	EPA 625	Benzoic acid
GC/MS	EPA 625	Benzo(ghi)perylene
GC/MS	EPA 625	Benzo(a)pyrene
GC/MS	EPA 625	Benzyl alcohol
GC/MS	EPA 625	1,1'-Biphenyl
GC/MS	EPA 625	bis(2-Chloroethoxy)methane
GC/MS	EPA 625	bis(2-Chloroethyl) ether
GC/MS	EPA 625	bis(2-Chloroisopropyl) ether
GC/MS	EPA 625	bis(2-Ethylhexyl) phthalate
GC/MS	EPA 625	4-Bromophenyl phenyl ether
GC/MS	EPA 625	n-Butylbenzenesulfonamide
GC/MS	EPA 625	Butyl benzyl phthalate
GC/MS	EPA 625	Caprolactam
GC/MS	EPA 625	Carbazole
GC/MS	EPA 625	4-Chloroaniline
GC/MS	EPA 625	Chlorobenzilate
GC/MS	EPA 625	p-Chlorobenzilate
GC/MS	EPA 625	4-Chloro-3-methylphenol
GC/MS	EPA 625	2-Chloronaphthalene
GC/MS	EPA 625	2-Chlorophenol
GC/MS	EPA 625	4-Chlorophenyl phenyl ether
GC/MS	EPA 625	Chrysene
GC/MS	EPA 625	Cresols (total)
GC/MS	EPA 625	Cyclohexanol
GC/MS	EPA 625	Diallate
GC/MS	EPA 625	Dibenz(a,h)anthracene
GC/MS	EPA 625	Dibenzo(a,h)anthracene
GC/MS	EPA 625	Dibenzofuran
GC/MS	EPA 625	Di-n-butyl phthalate

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Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625	1,2-Dichlorobenzene
GC/MS	EPA 625	1,3-Dichlorobenzene
GC/MS	EPA 625	1,4-Dichlorobenzene
GC/MS	EPA 625	3,3'-Dichlorobenzidine
GC/MS	EPA 625	2,4-Dichlorophenol
GC/MS	EPA 625	2,6-Dichlorophenol
GC/MS	EPA 625	Diethyl phthalate
GC/MS	EPA 625	O,O-Diethyl-O-(2-pyrazinyl) phosphorothioate
GC/MS	EPA 625	Dimethoate
GC/MS	EPA 625	p-Dimethylaminoazobenzene
GC/MS	EPA 625	7,12-Dimethylbenz(a)anthracene
GC/MS	EPA 625	3,3'-Dimethylbenzidine
GC/MS	EPA 625	Dimethylformamide
GC/MS	EPA 625	alpha,alpha-Dimethylphenethylamine
GC/MS	EPA 625	2,4-Dimethylphenol
GC/MS	EPA 625	Dimethyl phthalate
GC/MS	EPA 625	1,3-Dinitrobenzene
GC/MS	EPA 625	1,4-Dinitrobenzene
GC/MS	EPA 625	4,6-Dinitro-2-methylphenol
GC/MS	EPA 625	2,4-Dinitrophenol
GC/MS	EPA 625	2,4-Dinitrotoluene
GC/MS	EPA 625	2,6-Dinitrotoluene
GC/MS	EPA 625	2-sec-Butyl-4,6-dinitrophenol
GC/MS	EPA 625	Dinoseb
GC/MS	EPA 625	Di-n-octyl phthalate
GC/MS	EPA 625	1,4-Dioxane
GC/MS	EPA 625	1,2-Diphenylhydrazine (as Azobenzene)
GC/MS	EPA 625	Disulfoton
GC/MS	EPA 625	Ethyl methacrylate
GC/MS	EPA 625	Ethyl methanesulfonate
GC/MS	EPA 625	Famphur
GC/MS	EPA 625	Fluoranthene
GC/MS	EPA 625	Fluorene
GC/MS	EPA 625	Hexachlorobenzene
GC/MS	EPA 625	Hexachlorobutadiene
GC/MS	EPA 625	Hexachlorocyclopentadiene
GC/MS	EPA 625	Hexachloro-1,3-cyclopentadiene
GC/MS	EPA 625	Hexachloroethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625	Hexachlorophene
GC/MS	EPA 625	Hexachloropropene
GC/MS	EPA 625	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 625	Isodrin
GC/MS	EPA 625	Isophorone
GC/MS	EPA 625	Isosafrole
GC/MS	EPA 625	Kepone
GC/MS	EPA 625	Methapyrilene
GC/MS	EPA 625	2-Methylbenzenamine
GC/MS	EPA 625	3-Methylcholanthrene
GC/MS	EPA 625	4,4'-Methylenebis(2-chloroaniline)
GC/MS	EPA 625	Methyl methacrylate
GC/MS	EPA 625	Methyl methanesulfonate
GC/MS	EPA 625	2-Methylnaphthalene
GC/MS	EPA 625	Methyl parathion
GC/MS	EPA 625	2-Methylphenol
GC/MS	EPA 625	3-Methylphenol & 4-Methylphenol
GC/MS	EPA 625	2-Methylphenol, 3-methylphenol and 4-methylphenol
GC/MS	EPA 625	Methylphenols (total)
GC/MS	EPA 625	Naphthalene
GC/MS	EPA 625	1,4-Naphthoquinone
GC/MS	EPA 625	1-Naphthylamine
GC/MS	EPA 625	2-Naphthylamine
GC/MS	EPA 625	2-Nitroaniline
GC/MS	EPA 625	3-Nitroaniline
GC/MS	EPA 625	4-Nitroaniline
GC/MS	EPA 625	Nitrobenzene
GC/MS	EPA 625	2-Nitrophenol
GC/MS	EPA 625	4-Nitrophenol
GC/MS	EPA 625	4-Nitroquinoline-1-oxide
GC/MS	EPA 625	N-Nitrosodi-n-butylamine
GC/MS	EPA 625	N-Nitrosodiethylamine
GC/MS	EPA 625	N-Nitrosodimethylamine
GC/MS	EPA 625	N-Nitrosodiphenylamine
GC/MS	EPA 625	N-Nitrosodi-n-propylamine
GC/MS	EPA 625	N-Nitrosomethylethylamine
GC/MS	EPA 625	N-Nitrosomorpholine
GC/MS	EPA 625	N-Nitrosopiperidine

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 625	N-Nitrosopyrrolidine
GC/MS	EPA 625	5-Nitro-o-toluidine
GC/MS	EPA 625	2,2'-oxybis(1-Chloropropane)
GC/MS	EPA 625	Parathion
GC/MS	EPA 625	Pentachlorobenzene
GC/MS	EPA 625	Pentachloroethane
GC/MS	EPA 625	Pentachloronitrobenzene
GC/MS	EPA 625	Pentachlorophenol
GC/MS	EPA 625	Phenacetin
GC/MS	EPA 625	Phenanthrene
GC/MS	EPA 625	Phenol
GC/MS	EPA 625	p-Phenylene diamine
GC/MS	EPA 625	Phorate
GC/MS	EPA 625	2-Picoline
GC/MS	EPA 625	Pronamide
GC/MS	EPA 625	Pyrene
GC/MS	EPA 625	Pyridine
GC/MS	EPA 625	Safrole
GC/MS	EPA 625	Sulfotepp
GC/MS	EPA 625	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 625	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 625	Tetraethyldithiopyrophosphate (Sulfotepp)
GC/MS	EPA 625	Thionazin
GC/MS	EPA 625	o-Toluidine
GC/MS	EPA 625	Tributyl phosphate
GC/MS	EPA 625	1,2,4-Trichlorobenzene
GC/MS	EPA 625	2,4,5-Trichlorophenol
GC/MS	EPA 625	2,4,6-Trichlorophenol
GC/MS	EPA 625	O,O,O-Triethyl phosphorothioate
GC/MS	EPA 625	1,3,5-Trinitrobenzene
GC/MS	EPA 625	Tris(2-chloroethyl)phosphate
GC/MS	EPA 625	1-Methyl naphthalene
GC-ECD	EPA 8081B	Aldrin
GC-ECD	EPA 8081B	alpha-BHC
GC-ECD	EPA 8081B	beta-BHC
GC-ECD	EPA 8081B	delta-BHC
GC-ECD	EPA 8081B	gamma-BHC (Lindane)
GC-ECD	EPA 8081B	alpha-Chlordane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-ECD	EPA 8081B	gamma-Chlordane
GC-ECD	EPA 8081B	Chlordane (technical)
GC-ECD	EPA 8081B	4,4'-DDD
GC-ECD	EPA 8081B	2,4'-DDD
GC-ECD	EPA 8081B	4,4'-DDE
GC-ECD	EPA 8081B	2,4'-DDE
GC-ECD	EPA 8081B	4,4'-DDT
GC-ECD	EPA 8081B	2,4'-DDT
GC-ECD	EPA 8081B	Dieldrin
GC-ECD	EPA 8081B	Endosulfan I
GC-ECD	EPA 8081B	Endosulfan II
GC-ECD	EPA 8081B	Endosulfan sulfate
GC-ECD	EPA 8081B	Endrin
GC-ECD	EPA 8081B	Endrin aldehyde
GC-ECD	EPA 8081B	Endrin ketone
GC-ECD	EPA 8081B	Heptachlor
GC-ECD	EPA 8081B	Heptachlor epoxide
GC-ECD	EPA 8081B	Methoxychlor
GC-ECD	EPA 8081B	Toxaphene
GC-ECD	EPA 608	Aldrin
GC-ECD	EPA 608	alpha-BHC
GC-ECD	EPA 608	beta-BHC
GC-ECD	EPA 608	delta-BHC
GC-ECD	EPA 608	gamma-BHC (Lindane)
GC-ECD	EPA 608	alpha-Chlordane
GC-ECD	EPA 608	gamma-Chlordane
GC-ECD	EPA 608	Chlordane (technical)
GC-ECD	EPA 608	4,4'-DDD
GC-ECD	EPA 608	2,4'-DDD
GC-ECD	EPA 608	4,4'-DDE
GC-ECD	EPA 608	2,4'-DDE
GC-ECD	EPA 608	4,4'-DDT
GC-ECD	EPA 608	2,4'-DDT
GC-ECD	EPA 608	Dieldrin
GC-ECD	EPA 608	Endosulfan I
GC-ECD	EPA 608	Endosulfan II

Non-Potable Water

Technology	Method	Analyte
GC-ECD	EPA 608	Endosulfan sulfate
GC-ECD	EPA 608	Endrin
GC-ECD	EPA 608	Endrin aldehyde
GC-ECD	EPA 608	Endrin ketone
GC-ECD	EPA 608	Heptachlor
GC-ECD	EPA 608	Heptachlor epoxide
GC-ECD	EPA 608	Methoxychlor
GC-ECD	EPA 608	Toxaphene
GC-ECD	EPA 608	Aroclor 1016
GC-ECD	EPA 608	Aroclor 1221
GC-ECD	EPA 608	Aroclor 1232
GC-ECD	EPA 608	Aroclor 1242
GC-ECD	EPA 608	Aroclor 1248
GC-ECD	EPA 608	Aroclor 1254
GC-ECD	EPA 608	Aroclor 1260
GC-ECD	EPA 608	Aroclor 1262
GC-ECD	EPA 608	Aroclor 1268
GC-ECD	EPA 8082A	Aroclor 1016
GC-ECD	EPA 8082A	Aroclor 1221
GC-ECD	EPA 8082A	Aroclor 1232
GC-ECD	EPA 8082A	Aroclor 1242
GC-ECD	EPA 8082A	Aroclor 1248
GC-ECD	EPA 8082A	Aroclor 1254
GC-ECD	EPA 8082A	Aroclor 1260
GC-ECD	EPA 8082A	Aroclor 1262
GC-ECD	EPA 8082A	Aroclor 1268
GC-ECD	EPA 8151A	2,4-D
GC-ECD	EPA 8151A	Dalapon
GC-ECD	EPA 8151A	2,4-DB
GC-ECD	EPA 8151A	Dicamba
GC-ECD	EPA 8151A	Dichlorprop
GC-ECD	EPA 8151A	Dinoseb
GC-ECD	EPA 8151A	2,4,5-TP (Silvex)
GC-ECD	EPA 8151A	2,4,5-T
GC-FID	RSK-175	Methane
GC-FID	RSK-175	Ethane

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Non-Potable Water

Technology	Method	Analyte
GC-FID	RSK-175	Ethene
GC-FID	RSK-175	Acetylene
GC-FID	EPA 8015B	Ethanol
GC-FID	EPA 8015B	Methanol
GC-FID	EPA 8015B	Ethylene glycol
GC-FID	EPA 8015B	Propylene glycol
GC-FID	EPA 8015B	Diesel Range Organics
GC-FID	EPA 8015B	Motor Oil Range Organics
GC-FID	EPA 8015B	TPH (as Diesel)
GC-FID	EPA 8015B	Gasoline Range Organics
LC/MS/MS	EPA 8321A	2-Amino-4,6-dinitrotoluene
LC/MS/MS	EPA 8321A	4-Amino-2,6-dinitrotoluene
LC/MS/MS	EPA 8321A	3,5-Dinitroaniline
LC/MS/MS	EPA 8321A	1,3-Dinitrobenzene
LC/MS/MS	EPA 8321A	2,4-Dinitrotoluene
LC/MS/MS	EPA 8321A	2,6-Dinitrotoluene
LC/MS/MS	EPA 8321A	DNX
LC/MS/MS	EPA 8321A	HMX
LC/MS/MS	EPA 8321A	HNAB
LC/MS/MS	EPA 8321A	HNS
LC/MS/MS	EPA 8321A	MNX
LC/MS/MS	EPA 8321A	Nitrobenzene
LC/MS/MS	EPA 8321A	Nitroglycerin
LC/MS/MS	EPA 8321A	4-Nitrotoluene
LC/MS/MS	EPA 8321A	3-Nitrotoluene
LC/MS/MS	EPA 8321A	2-Nitrotoluene
LC/MS/MS	EPA 8321A	PETN
LC/MS/MS	EPA 8321A	RDX
LC/MS/MS	EPA 8321A	TATB
LC/MS/MS	EPA 8321A	Tetryl
LC/MS/MS	EPA 8321A	TNX
LC/MS/MS	EPA 8321A	1,3,5-Trinitrobenzene
LC/MS/MS	EPA 8321A	2,4,6-Trinitrotoluene
LC/MS/MS	EPA 8321A	Tris (o-cresyl) Phosphate
LC/MS/MS	EPA 8321A	2,4-diamino-6-nitrotoluene
LC/MS/MS	EPA 8321A	2,6-diamino-4-nitrotoluene

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Non-Potable Water		
Technology	**Method**	**Analyte**
HPLC	EPA 8330B	2-Amino-4,6-dinitrotoluene
HPLC	EPA 8330B	4-Amino-2,6-dinitrotoluene
HPLC	EPA 8330B	1,3-Dinitrobenzene
HPLC	EPA 8330B	2,4-Dinitrotoluene
HPLC	EPA 8330B	2,6-Dinitrotoluene
HPLC	EPA 8330B	HMX
HPLC	EPA 8330B	HNAB
HPLC	EPA 8330B	HNS
HPLC	EPA 8330B	Nitrobenzene
HPLC	EPA 8330B	Nitroglycerin
HPLC	EPA 8330B	2-Nitrotoluene
HPLC	EPA 8330B	3-Nitrotoluene
HPLC	EPA 8330B	4-Nitrotoluene
HPLC	EPA 8330B	PETN
HPLC	EPA 8330B	RDX
HPLC	EPA 8330B	TATB
HPLC	EPA 8330B	Tetryl
HPLC	EPA 8330B	MNX
HPLC	EPA 8330B	DNX
HPLC	EPA 8330B	TNX
HPLC	EPA 8330B	1,3,5-Trinitrobenzene
HPLC	EPA 8330B	2,4,6-Trinitrotoluene
GC/MS	EPA 8270D SIM	Acenaphthene
GC/MS	EPA 8270D SIM	Acenaphthylene
GC/MS	EPA 8270D SIM	Anthracene
GC/MS	EPA 8270D SIM	Benzo(a)anthracene
GC/MS	EPA 8270D SIM	Benzo(b)fluoranthene
GC/MS	EPA 8270D SIM	Benzo(k)fluoranthene
GC/MS	EPA 8270D SIM	Benzo(ghi)perylene
GC/MS	EPA 8270D SIM	Benzo(a)pyrene
GC/MS	EPA 8270D SIM	Chrysene
GC/MS	EPA 8270D SIM	Dibenz(a,h)anthracene
GC/MS	EPA 8270D SIM	Fluoranthene
GC/MS	EPA 8270D SIM	Fluorene
GC/MS	EPA 8270D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D SIM	Naphthalene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D SIM	Phenanthrene
GC/MS	EPA 8270D SIM	Pyrene
LC/MS/MS	EPA 6850	Perchlorate
ICP-MS	EPA 6020A	Aluminum
ICP-MS	EPA 6020A	Antimony
ICP-MS	EPA 6020A	Arsenic
ICP-MS	EPA 6020A	Barium
ICP-MS	EPA 6020A	Beryllium
ICP-MS	EPA 6020A	Bismuth
ICP-MS	EPA 6020A	Boron
ICP-MS	EPA 6020A	Cadmium
ICP-MS	EPA 6020A	Calcium
ICP-MS	EPA 6020A	Cerium
ICP-MS	EPA 6020A	Cesium
ICP-MS	EPA 6020A	Chromium
ICP-MS	EPA 6020A	Cobalt
ICP-MS	EPA 6020A	Copper
ICP-MS	EPA 6020A	Hafnium
ICP-MS	EPA 6020A	Iron
ICP-MS	EPA 6020A	Lanthanum
ICP-MS	EPA 6020A	Lead
ICP-MS	EPA 6020A	Lithium
ICP-MS	EPA 6020A	Magnesium
ICP-MS	EPA 6020A	Manganese
ICP-MS	EPA 6020A	Molybdenum
ICP-MS	EPA 6020A	Neodymium
ICP-MS	EPA 6020A	Nickel
ICP-MS	EPA 6020A	Niobium
ICP-MS	EPA 6020A	Palladium
ICP-MS	EPA 6020A	Phosphorus
ICP-MS	EPA 6020A	Platinum
ICP-MS	EPA 6020A	Potassium
ICP-MS	EPA 6020A	Praseodymium
ICP-MS	EPA 6020A	Rhodium
ICP-MS	EPA 6020A	Ruthenium
ICP-MS	EPA 6020A	Samarium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 6020A	Selenium
ICP-MS	EPA 6020A	Silicon
ICP-MS	EPA 6020A	Silver
ICP-MS	EPA 6020A	Sodium
ICP-MS	EPA 6020A	Strontium
ICP-MS	EPA 6020A	Sulfur
ICP-MS	EPA 6020A	Tantalum
ICP-MS	EPA 6020A	Tellurium
ICP-MS	EPA 6020A	Thallium
ICP-MS	EPA 6020A	Thorium
ICP-MS	EPA 6020A	Tin
ICP-MS	EPA 6020A	Titanium
ICP-MS	EPA 6020A	Tungsten
ICP-MS	EPA 6020A	Uranium
ICP-MS	EPA 6020A	Uranium 233
ICP-MS	EPA 6020A	Uranium 234
ICP-MS	EPA 6020A	Uranium 235
ICP-MS	EPA 6020A	Uranium 236
ICP-MS	EPA 6020A	Uranium 238
ICP-MS	EPA 6020A	Vanadium
ICP-MS	EPA 6020A	Yttrium
ICP-MS	EPA 6020A	Zinc
ICP-MS	EPA 6020A	Zirconium
ICP-MS	EPA 200.8	Aluminum
ICP-MS	EPA 200.8	Antimony
ICP-MS	EPA 200.8	Arsenic
ICP-MS	EPA 200.8	Barium
ICP-MS	EPA 200.8	Beryllium
ICP-MS	EPA 200.8	Bismuth
ICP-MS	EPA 200.8	Boron
ICP-MS	EPA 200.8	Cadmium
ICP-MS	EPA 200.8	Calcium
ICP-MS	EPA 200.8	Cerium
ICP-MS	EPA 200.8	Cesium
ICP-MS	EPA 200.8	Chromium
ICP-MS	EPA 200.8	Cobalt

Non-Potable Water

Technology	Method	Analyte
ICP-MS	EPA 200.8	Copper
ICP-MS	EPA 200.8	Hafnium
ICP-MS	EPA 200.8	Iron
ICP-MS	EPA 200.8	Lanthanum
ICP-MS	EPA 200.8	Lead
ICP-MS	EPA 200.8	Lithium
ICP-MS	EPA 200.8	Magnesium
ICP-MS	EPA 200.8	Manganese
ICP-MS	EPA 200.8	Molybdenum
ICP-MS	EPA 200.8	Neodymium
ICP-MS	EPA 200.8	Nickel
ICP-MS	EPA 200.8	Niobium
ICP-MS	EPA 200.8	Palladium
ICP-MS	EPA 200.8	Phosphorus
ICP-MS	EPA 200.8	Platinum
ICP-MS	EPA 200.8	Potassium
ICP-MS	EPA 200.8	Praseodymium
ICP-MS	EPA 200.8	Rhodium
ICP-MS	EPA 200.8	Ruthenium
ICP-MS	EPA 200.8	Samarium
ICP-MS	EPA 200.8	Selenium
ICP-MS	EPA 200.8	Silicon
ICP-MS	EPA 200.8	Silver
ICP-MS	EPA 200.8	Sodium
ICP-MS	EPA 200.8	Strontium
ICP-MS	EPA 200.8	Sulfur
ICP-MS	EPA 200.8	Tantalum
ICP-MS	EPA 200.8	Tellurium
ICP-MS	EPA 200.8	Thallium
ICP-MS	EPA 200.8	Thorium
ICP-MS	EPA 200.8	Tin
ICP-MS	EPA 200.8	Titanium
ICP-MS	EPA 200.8	Tungsten
ICP-MS	EPA 200.8	Uranium
ICP-MS	EPA 200.8	Vanadium
ICP-MS	EPA 200.8	Yttrium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 200.8	Zinc
ICP-MS	EPA 200.8	Zirconium
ICP-AES	EPA 200.7	Aluminum
ICP-AES	EPA 200.7	Antimony
ICP-AES	EPA 200.7	Arsenic
ICP-AES	EPA 200.7	Barium
ICP-AES	EPA 200.7	Beryllium
ICP-AES	EPA 200.7	Bismuth
ICP-AES	EPA 200.7	Boron
ICP-AES	EPA 200.7	Cadmium
ICP-AES	EPA 200.7	Calcium
ICP-AES	EPA 200.7	Chromium
ICP-AES	EPA 200.7	Cobalt
ICP-AES	EPA 200.7	Copper
ICP-AES	EPA 200.7	Iron
ICP-AES	EPA 200.7	Lead
ICP-AES	EPA 200.7	Lithium
ICP-AES	EPA 200.7	Magnesium
ICP-AES	EPA 200.7	Manganese
ICP-AES	EPA 200.7	Molybdenum
ICP-AES	EPA 200.7	Nickel
ICP-AES	EPA 200.7	Phosphorus
ICP-AES	EPA 200.7	Potassium
ICP-AES	EPA 200.7	Selenium
ICP-AES	EPA 200.7	Silicon
ICP-AES	EPA 200.7	Silver
ICP-AES	EPA 200.7	Sodium
ICP-AES	EPA 200.7	Strontium
ICP-AES	EPA 200.7	Sulfur
ICP-AES	EPA 200.7	Thallium
ICP-AES	EPA 200.7	Thorium
ICP-AES	EPA 200.7	Tin
ICP-AES	EPA 200.7	Titanium
ICP-AES	EPA 200.7	Uranium
ICP-AES	EPA 200.7	Vanadium
ICP-AES	EPA 200.7	Zinc

Non-Potable Water		
Technology	**Method**	**Analyte**
CVAA	EPA 7470A	Mercury
Colorimetric	EPA 9010C EPA 9012B	Cyanide
Ion Chromatrography	EPA 300.0/9056A	Bromide
Ion Chromatrography	EPA 300.0/9056A	Chloride
Ion Chromatrography	EPA 300.0/9056A	Fluoride
Ion Chromatrography	EPA 300.0/9056A	Nitrate
Ion Chromatrography	EPA 300.0/9056A	Nitrite
Ion Chromatrography	EPA 300.0/9056A	Sulfate
Ion Chromatrography	EPA 300.0/9056A	Ortho-phosphate
Ion Chromatrography	EPA 300.0/9056A	Iodide
Ion Chromatrography	EPA 314.0	Perchlorate
Gravimetric	SM 2540B SM 2540C SM 2540D	Solids
Probe	EPA 9040C EPA 9045D EPA 150.1	pH
Titration	SM 2320B EPA 310.1	Alkalinity
Titration	EPA 9030	Sulfide
Penske-Martin	EPA 1010A	Ignitability
Colormetric	EPA 353.1	nitrate/Nitrite
Colormetric	EPA 350.1	Ammonia
TOC Analyzer	EPA 9060A	TOC
Tritrmetric	EPA 9020B	TOX
Colormetric	EPA 7196A	Hex Chromium
Gravimetric	EPA 1664A	Oil & Grease
Gravimetric	EPA 1664A	TPH
Probe	EPA 9050A	Conductivity
Gas Flow Proportional Counter	EPA 900.0 EPA 9310	gross alpha/beta
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	Radium-226
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	total radium

Non-Potable Water		
Technology	**Method**	**Analyte**
Gas Flow Proportional Counter	EPA 904.0 EPA 9320	Radium-228
Gas Flow Proportional Counter	EPA 905.0 / DOE HASL 300 Sr-02	Strontium-90
Liquid Scintillation Counter	EPA 906.0	Tritium
Liquid Scintillation Counter	Eichrom Technologies TCW01/TCS01	Tecnetium-99
Liquid Scintillation Counter	EERF C-01-C14	Carbon-14
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Gamma Emitters:
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 227 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Americium 241
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 124
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 125
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium-137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium/Lanthanum-140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 133
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Beryllium 7
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 211 eq Th-227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 207
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth-210M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 214
Gamma Spectroscopy	EPA 901.1 / DOE	Calcium-45

Non-Potable Water		
Technology	**Method**	**Analyte**
	HASL 300 Ga-01-R	
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 141
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 139
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 134
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 57
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 58
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 60
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 152
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 154
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 155
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Hafnium 181
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iodine 131
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iridium 192
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iron 59
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lanthanum 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 210
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 211
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 214

Non-Potable Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese-56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese 54
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Mercury 203
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 237
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 239
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 83
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 94
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 95
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Potassium 40
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 146
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 147
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium (226)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 223 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 224
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Ruthenium 106
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Scandium 46
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 22

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Non-Potable Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 24
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Strontium 85
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thallium 208
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 230
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 232
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Tin 113
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 235
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 238
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Vanadium-48
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Yttrium 88
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zinc 65
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zirconium 95
Alpha Spectroscopy	DOE HASL 300 A-01-R	Alpha spec analysis:
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Uranium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Thorium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Americium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Plutonium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Neptunium

Non-Potable Water		
Technology	**Method**	**Analyte**
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Curium
Liquid Scintillation Counter	Eichrom Technologies OTW01, OTS01	Lead-210
Alpha Spectroscopy	Laboratory SOP ST-RC-0210	Polonium-210
Liquid Scintillation Counter	Eichrom Technologies FEW01	Iron-55
Liquid Scintillation Counter	DOE RP-300	Nickel 59/63
Liquid Scintillation Counter	SM 7500-IB	Iodine-129
Preparation	**Method**	**Type**
Organic Extraction & Sample Prep	EPA 3500C	Organic Extraction & Sample Prep
Volatile Prep	EPA 5000	Sample Preparation for Volatile Organic Compounds
Organic Cleanup	EPA 3600A	Cleanup for Organic extracts
Organic prep/analysis	EPA 8000C	Determinative Chromatographic Separations
Acid Digestion (Aqueous samples)	EPA 3010A	Acid Digestion for Metals (Aqueous samples)
Purge & Trap	EPA 5030C	Purge & Trap for Aqueous Volatile
Sep Funnel Liquid-Liquid Extraction	EPA 3510C	Sep Funnel Liquid-Liquid Extraction
Organic Cleanup	EPA 3600A	Cleanup for Organic extracts
Florisil Cleanup	EPA 3620C	Florisil Cleanup
Sulfur Cleanup	EPA 3660B	Sulfur Cleanup
Acid Clean Up	EPA 3665A	Acid Clean Up for PCBs
TCLP Extraction	EPA 1311	TCLP Extraction
SPLP Extraction	EPA 1312	SPLP Extraction
CWET Extraction	CA Title 22	CWET Extraction
Solid Phase Extraction	EPA 3535A	Solid Phase Extraction

Drinking Water		
Technology	**Method**	**Analyte**
Gas Flow Proportional Counter	EPA 900.0 EPA 9310	gross alpha/beta
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	Radium-226
Gas Flow Proportional Counter	EPA 904.0 EPA 9320	Radium-228
Gas Flow Proportional Counter	EPA 905.0 / DOE HASL 300 Sr-02	Strontium-90
Liquid Scintillation Counter	EPA 906.0	Tritium
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Gamma Emitters:
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 227 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Americium 241
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 124
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 125
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium-137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium/Lanthanum-140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 133
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Beryllium 7
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 211 eq Th-227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 207
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth-210M

Drinking Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Calcium-45
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 141
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 139
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 134
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 57
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 58
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 60
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 152
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 154
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 155
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Hafnium 181
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iodine 131
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iridium 192
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iron 59
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lanthanum 140

Drinking Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 210
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 211
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese-56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese 54
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Mercury 203
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 237
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 239
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 83
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 94
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 95
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Potassium 40
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 146
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 147
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium (226)

Drinking Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 223 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 224
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Ruthenium 106
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Scandium 46
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 22
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 24
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Strontium 85
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thallium 208
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 230
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 232
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Tin 113
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 235
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 238
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Vanadium-48
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Yttrium 88

Drinking Water		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zinc 65
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zirconium 95

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP-AES	EPA 6010C	Aluminum
ICP-AES	EPA 6010C	Antimony
ICP-AES	EPA 6010C	Arsenic
ICP-AES	EPA 6010C	Barium
ICP-AES	EPA 6010C	Beryllium
ICP-AES	EPA 6010C	Bismuth
ICP-AES	EPA 6010C	Boron
ICP-AES	EPA 6010C	Cadmium
ICP-AES	EPA 6010C	Calcium
ICP-AES	EPA 6010C	Chromium
ICP-AES	EPA 6010C	Cobalt
ICP-AES	EPA 6010C	Copper
ICP-AES	EPA 6010C	Iron
ICP-AES	EPA 6010C	Lead
ICP-AES	EPA 6010C	Lithium
ICP-AES	EPA 6010C	Magnesium
ICP-AES	EPA 6010C	Manganese
ICP-AES	EPA 6010C	Molybdenum
ICP-AES	EPA 6010C	Nickel
ICP-AES	EPA 6010C	Phosphorus
ICP-AES	EPA 6010C	Potassium
ICP-AES	EPA 6010C	Selenium
ICP-AES	EPA 6010C	Silicon
ICP-AES	EPA 6010C	Silver
ICP-AES	EPA 6010C	Sodium
ICP-AES	EPA 6010C	Strontium
ICP-AES	EPA 6010C	Sulfur

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP-AES	EPA 6010C	Thallium
ICP-AES	EPA 6010C	Thorium
ICP-AES	EPA 6010C	Tin
ICP-AES	EPA 6010C	Titanium
ICP-AES	EPA 6010C	Uranium
ICP-AES	EPA 6010C	Vanadium
ICP-AES	EPA 6010C	Zinc
GC/MS	EPA 8260C	Acetone
GC/MS	EPA 8260C	Acetonitrile
GC/MS	EPA 8260C	Acrolein
GC/MS	EPA 8260C	Acrylonitrile
GC/MS	EPA 8260C	Benzene
GC/MS	EPA 8260C	Benzyl chloride
GC/MS	EPA 8260C	Bromobenzene
GC/MS	EPA 8260C	Bromochloromethane
GC/MS	EPA 8260C	Bromodichloromethane
GC/MS	EPA 8260C	Bromoform
GC/MS	EPA 8260C	Bromomethane
GC/MS	EPA 8260C	n-Butanol
GC/MS	EPA 8260C	2-Butanone
GC/MS	EPA 8260C	n-Butylbenzene
GC/MS	EPA 8260C	sec-Butylbenzene
GC/MS	EPA 8260C	tert-Butylbenzene
GC/MS	EPA 8260C	Carbon disulfide
GC/MS	EPA 8260C	Carbon tetrachloride
GC/MS	EPA 8260C	Chlorobenzene
GC/MS	EPA 8260C	Chlorobromomethane
GC/MS	EPA 8260C	2-Chloro-1,3-butadiene
GC/MS	EPA 8260C	Chlorodibromomethane
GC/MS	EPA 8260C	Dibromochloromethane
GC/MS	EPA 8260C	Chloroethane
GC/MS	EPA 8260C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260C	Chloroform
GC/MS	EPA 8260C	Chloromethane
GC/MS	EPA 8260C	Allyl chloride
GC/MS	EPA 8260C	2-Chlorotoluene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	4-Chlorotoluene
GC/MS	EPA 8260C	Cyclohexane
GC/MS	EPA 8260C	Cyclohexanone
GC/MS	EPA 8260C	1,2-Dibromo-3-chloropropane
GC/MS	EPA 8260C	1,2-Dibromoethane
GC/MS	EPA 8260C	Dibromomethane
GC/MS	EPA 8260C	1,2-Dichlorobenzene
GC/MS	EPA 8260C	1,3-Dichlorobenzene
GC/MS	EPA 8260C	1,4-Dichlorobenzene
GC/MS	EPA 8260C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260C	Dichlorodifluoromethane
GC/MS	EPA 8260C	1,1-Dichloroethane
GC/MS	EPA 8260C	1,2-Dichloroethane
GC/MS	EPA 8260C	cis-1,2-Dichloroethene
GC/MS	EPA 8260C	trans-1,2-Dichloroethene
GC/MS	EPA 8260C	1,1-Dichloroethene
GC/MS	EPA 8260C	1,2-Dichloroethene (total)
GC/MS	EPA 8260C	1,2-Dichloropropane
GC/MS	EPA 8260C	1,3-Dichloropropane
GC/MS	EPA 8260C	2,2-Dichloropropane
GC/MS	EPA 8260C	cis-1,3-Dichloropropene
GC/MS	EPA 8260C	trans-1,3-Dichloropropene
GC/MS	EPA 8260C	1,1-Dichloropropene
GC/MS	EPA 8260C	1,2-Dichloro-1,1,2,2-tetrafluoroethane
GC/MS	EPA 8260C	Dimethyl disulfide
GC/MS	EPA 8260C	1,4-Dioxane
GC/MS	EPA 8260C	Ethyl acetate
GC/MS	EPA 8260C	Ethylbenzene
GC/MS	EPA 8260C	Ethyl ether
GC/MS	EPA 8260C	Diethyl ether
GC/MS	EPA 8260C	Ethyl methacrylate
GC/MS	EPA 8260C	Freon 113
GC/MS	EPA 8260C	Hexachlorobutadiene
GC/MS	EPA 8260C	n-Hexane
GC/MS	EPA 8260C	2-Hexanone
GC/MS	EPA 8260C	Iodomethane

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8260C	Isobutanol
GC/MS	EPA 8260C	Isopropylbenzene
GC/MS	EPA 8260C	p-Isopropyltoluene
GC/MS	EPA 8260C	Methacrylonitrile
GC/MS	EPA 8260C	Methyl acetate
GC/MS	EPA 8260C	Methyl butyl ketone
GC/MS	EPA 8260C	Methylcyclohexane
GC/MS	EPA 8260C	Dichloromethane
GC/MS	EPA 8260C	Methylene chloride
GC/MS	EPA 8260C	Methyl methacrylate
GC/MS	EPA 8260C	4-Methyl-2-pentanone
GC/MS	EPA 8260C	MTBE
GC/MS	EPA 8260C	Naphthalene
GC/MS	EPA 8260C	2-Nitropropane
GC/MS	EPA 8260C	Nonanal
GC/MS	EPA 8260C	Pentachloroethane
GC/MS	EPA 8260C	Propionitrile
GC/MS	EPA 8260C	n-Propylbenzene
GC/MS	EPA 8260C	Styrene
GC/MS	EPA 8260C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260C	Tetrachloroethene
GC/MS	EPA 8260C	Tetrahydrofuran
GC/MS	EPA 8260C	Toluene
GC/MS	EPA 8260C	1,3,5-Trichlorobenzene
GC/MS	EPA 8260C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260C	1,2,4-Trichlorobenzene
GC/MS	EPA 8260C	1,1,1-Trichloroethane
GC/MS	EPA 8260C	1,1,2-Trichloroethane
GC/MS	EPA 8260C	Trichloroethene
GC/MS	EPA 8260C	Trichlorofluoromethane
GC/MS	EPA 8260C	1,2,3-Trichloropropane
GC/MS	EPA 8260C	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 8260C	Trichlorotrifluoroethane
GC/MS	EPA 8260C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260C	1,3,5-Trimethylbenzene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	Vinyl acetate
GC/MS	EPA 8260C	Vinyl chloride
GC/MS	EPA 8260C	m-Xylene & p-Xylene
GC/MS	EPA 8260C	o-Xylene
GC/MS	EPA 8260C	Xylenes (total)
GC/MS	EPA 8270D	Acenaphthene
GC/MS	EPA 8270D	Acenaphthylene
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	2-Acetylaminofluorene
GC/MS	EPA 8270D	4-Aminobiphenyl
GC/MS	EPA 8270D	Aniline
GC/MS	EPA 8270D	Anthracene
GC/MS	EPA 8270D	Aramite (total)
GC/MS	EPA 8270D	Atrazine
GC/MS	EPA 8270D	Azobenzene
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D	Benzo(a)anthracene
GC/MS	EPA 8270D	Benzo(b)fluoranthene
GC/MS	EPA 8270D	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Benzoic acid
GC/MS	EPA 8270D	Benzo(ghi)perylene
GC/MS	EPA 8270D	Benzo(a)pyrene
GC/MS	EPA 8270D	Benzyl alcohol
GC/MS	EPA 8270D	1,1'-Biphenyl
GC/MS	EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270D	bis(2-Chloroisopropyl) ether
GC/MS	EPA 8270D	bis(2-Ethylhexyl) phthalate
GC/MS	EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270D	n-Butylbenzenesulfonamide
GC/MS	EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	Chlorobenzilate

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8270D	p-Chlorobenzilate
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	4-Chlorophenyl phenyl ether
GC/MS	EPA 8270D	Chrysene
GC/MS	EPA 8270D	Cresols (total)
GC/MS	EPA 8270D	Cyclohexanol
GC/MS	EPA 8270D	Diallate
GC/MS	EPA 8270D	Dibenz(a,h)anthracene
GC/MS	EPA 8270D	Dibenzo(a,h)anthracene
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 8270D	1,2-Dichlorobenzene
GC/MS	EPA 8270D	1,3-Dichlorobenzene
GC/MS	EPA 8270D	1,4-Dichlorobenzene
GC/MS	EPA 8270D	3,3'-Dichlorobenzidine
GC/MS	EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 8270D	2,6-Dichlorophenol
GC/MS	EPA 8270D	Diethyl phthalate
GC/MS	EPA 8270D	O,O-Diethyl-O-(2-pyrazinyl) phosphorothioate
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	p-Dimethylaminoazobenzene
GC/MS	EPA 8270D	7,12-Dimethylbenz(a)anthracene
GC/MS	EPA 8270D	3,3'-Dimethylbenzidine
GC/MS	EPA 8270D	Dimethylformamide
GC/MS	EPA 8270D	alpha,alpha-Dimethylphenethylamine
GC/MS	EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	1,3-Dinitrobenzene
GC/MS	EPA 8270D	1,4-Dinitrobenzene
GC/MS	EPA 8270D	4,6-Dinitro-2-methylphenol
GC/MS	EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 8270D	2,4-Dinitrotoluene
GC/MS	EPA 8270D	2,6-Dinitrotoluene
GC/MS	EPA 8270D	2-sec-Butyl-4,6-dinitrophenol

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8270D	Dinoseb
GC/MS	EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 8270D	1,4-Dioxane
GC/MS	EPA 8270D	1,2-Diphenylhydrazine (as Azobenzene)
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Ethyl methacrylate
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Fluoranthene
GC/MS	EPA 8270D	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloro-1,3-cyclopentadiene
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Hexachlorophene
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 8270D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isodrin
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	Methapyrilene
GC/MS	EPA 8270D	2-Methylbenzenamine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 8270D	4,4'-Methylenebis(2-chloroaniline)
GC/MS	EPA 8270D	Methyl methacrylate
GC/MS	EPA 8270D	Methyl methanesulfonate
GC/MS	EPA 8270D	2-Methylnaphthalene
GC/MS	EPA 8270D	Methyl parathion
GC/MS	EPA 8270D	2-Methylphenol
GC/MS	EPA 8270D	3-Methylphenol & 4-Methylphenol
GC/MS	EPA 8270D	2-Methylphenol, 3-methylphenol and 4-methylphenol
GC/MS	EPA 8270D	Methylphenols (total)
GC/MS	EPA 8270D	Naphthalene
GC/MS	EPA 8270D	1,4-Naphthoquinone

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Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	4-Nitroquinoline-1-oxide
GC/MS	EPA 8270D	N-Nitrosodi-n-butylamine
GC/MS	EPA 8270D	N-Nitrosodiethylamine
GC/MS	EPA 8270D	N-Nitrosodimethylamine
GC/MS	EPA 8270D	N-Nitrosodiphenylamine
GC/MS	EPA 8270D	N-Nitrosodi-n-propylamine
GC/MS	EPA 8270D	N-Nitrosomethylethylamine
GC/MS	EPA 8270D	N-Nitrosomorpholine
GC/MS	EPA 8270D	N-Nitrosopiperidine
GC/MS	EPA 8270D	N-Nitrosopyrrolidine
GC/MS	EPA 8270D	5-Nitro-o-toluidine
GC/MS	EPA 8270D	2,2'-oxybis(1-Chloropropane)
GC/MS	EPA 8270D	Parathion
GC/MS	EPA 8270D	Pentachlorobenzene
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Pentachloronitrobenzene
GC/MS	EPA 8270D	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 8270D	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	p-Phenylene diamine
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	2-Picoline
GC/MS	EPA 8270D	Pronamide
GC/MS	EPA 8270D	Pyrene
GC/MS	EPA 8270D	Pyridine
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	Sulfotepp

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270D	Tetraethyldithiopyrophosphate (Sulfotepp)
GC/MS	EPA 8270D	Thionazin
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	Tributyl phosphate
GC/MS	EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 8270D	O,O,O-Triethyl phosphorothioate
GC/MS	EPA 8270D	1,3,5-Trinitrobenzene
GC/MS	EPA 8270D	Tris(2-chloroethyl)phosphate
GC/MS	EPA 8270D	1-Methyl naphthalene
GC-ECD	EPA 8081B	Aldrin
GC-ECD	EPA 8081B	alpha-BHC
GC-ECD	EPA 8081B	beta-BHC
GC-ECD	EPA 8081B	delta-BHC
GC-ECD	EPA 8081B	gamma-BHC (Lindane)
GC-ECD	EPA 8081B	alpha-Chlordane
GC-ECD	EPA 8081B	gamma-Chlordane
GC-ECD	EPA 8081B	Chlordane (technical)
GC-ECD	EPA 8081B	4,4'-DDD
GC-ECD	EPA 8081B	2,4'-DDD
GC-ECD	EPA 8081B	4,4'-DDE
GC-ECD	EPA 8081B	2,4'-DDE
GC-ECD	EPA 8081B	4,4'-DDT
GC-ECD	EPA 8081B	2,4'-DDT
GC-ECD	EPA 8081B	Dieldrin
GC-ECD	EPA 8081B	Endosulfan I
GC-ECD	EPA 8081B	Endosulfan II
GC-ECD	EPA 8081B	Endosulfan sulfate
GC-ECD	EPA 8081B	Endrin
GC-ECD	EPA 8081B	Endrin aldehyde
GC-ECD	EPA 8081B	Endrin ketone
GC-ECD	EPA 8081B	Heptachlor
GC-ECD	EPA 8081B	Heptachlor epoxide

Solid and Chemical Materials

Technology	Method	Analyte
GC-ECD	EPA 8081B	Methoxychlor
GC-ECD	EPA 8081B	Toxaphene
GC-ECD	EPA 8082A	Aroclor 1016
GC-ECD	EPA 8082A	Aroclor 1221
GC-ECD	EPA 8082A	Aroclor 1232
GC-ECD	EPA 8082A	Aroclor 1242
GC-ECD	EPA 8082A	Aroclor 1248
GC-ECD	EPA 8082A	Aroclor 1254
GC-ECD	EPA 8082A	Aroclor 1260
GC-ECD	EPA 8082A	Aroclor 1262
GC-ECD	EPA 8082A	Aroclor 1268
GC-ECD	EPA 8151A	2,4-D
GC-ECD	EPA 8151A	Dalapon
GC-ECD	EPA 8151A	2,4-DB
GC-ECD	EPA 8151A	Dicamba
GC-ECD	EPA 8151A	Dichlorprop
GC-ECD	EPA 8151A	Dinoseb
GC-ECD	EPA 8151A	2,4,5-TP (Silvex)
GC-ECD	EPA 8151A	2,4,5-T
LC/MS/MS	EPA 8321A	2-Amino-4,6-dinitrotoluene
LC/MS/MS	EPA 8321A	4-Amino-2,6-dinitrotoluene
LC/MS/MS	EPA 8321A	3,5-Dinitroaniline
LC/MS/MS	EPA 8321A	1,3-Dinitrobenzene
LC/MS/MS	EPA 8321A	2,4-Dinitrotoluene
LC/MS/MS	EPA 8321A	2,6-Dinitrotoluene
LC/MS/MS	EPA 8321A	DNX
LC/MS/MS	EPA 8321A	HMX
LC/MS/MS	EPA 8321A	HNAB
LC/MS/MS	EPA 8321A	HNS
LC/MS/MS	EPA 8321A	MNX
LC/MS/MS	EPA 8321A	Nitrobenzene
LC/MS/MS	EPA 8321A	Nitroglycerin
LC/MS/MS	EPA 8321A	4-Nitrotoluene
LC/MS/MS	EPA 8321A	3-Nitrotoluene
LC/MS/MS	EPA 8321A	2-Nitrotoluene
LC/MS/MS	EPA 8321A	PETN

Solid and Chemical Materials

Technology	Method	Analyte
LC/MS/MS	EPA 8321A	RDX
LC/MS/MS	EPA 8321A	TATB
LC/MS/MS	EPA 8321A	Tetryl
LC/MS/MS	EPA 8321A	TNX
LC/MS/MS	EPA 8321A	1,3,5-Trinitrobenzene
LC/MS/MS	EPA 8321A	2,4,6-Trinitrotoluene
LC/MS/MS	EPA 8321A	Tris (o-cresyl) Phosphate
LC/MS/MS	EPA 8321A	2,4-diamino-6-nitrotoluene
LC/MS/MS	EPA 8321A	2,6-diamino-4-nitrotoluene
HPLC	EPA 8330B	2-Amino-4,6-dinitrotoluene
HPLC	EPA 8330B	4-Amino-2,6-dinitrotoluene
HPLC	EPA 8330B	1,3-Dinitrobenzene
HPLC	EPA 8330B	2,4-Dinitrotoluene
HPLC	EPA 8330B	2,6-Dinitrotoluene
HPLC	EPA 8330B	HMX
HPLC	EPA 8330B	HNAB
HPLC	EPA 8330B	HNS
HPLC	EPA 8330B	Nitrobenzene
HPLC	EPA 8330B	Nitroglycerin
HPLC	EPA 8330B	2-Nitrotoluene
HPLC	EPA 8330B	3-Nitrotoluene
HPLC	EPA 8330B	4-Nitrotoluene
HPLC	EPA 8330B	PETN
HPLC	EPA 8330B	RDX
HPLC	EPA 8330B	TATB
HPLC	EPA 8330B	Tetryl
HPLC	EPA 8330B	MNX
HPLC	EPA 8330B	DNX
HPLC	EPA 8330B	TNX
HPLC	EPA 8330B	1,3,5-Trinitrobenzene
HPLC	EPA 8330B	2,4,6-Trinitrotoluene
GC/MS	EPA 8270D SIM	Acenaphthene
GC/MS	EPA 8270D SIM	Acenaphthylene
GC/MS	EPA 8270D SIM	Anthracene
GC/MS	EPA 8270D SIM	Benzo(a)anthracene
GC/MS	EPA 8270D SIM	Benzo(b)fluoranthene

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Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8270D SIM	Benzo(k)fluoranthene
GC/MS	EPA 8270D SIM	Benzo(ghi)perylene
GC/MS	EPA 8270D SIM	Benzo(a)pyrene
GC/MS	EPA 8270D SIM	Chrysene
GC/MS	EPA 8270D SIM	Dibenz(a,h)anthracene
GC/MS	EPA 8270D SIM	Fluoranthene
GC/MS	EPA 8270D SIM	Fluorene
GC/MS	EPA 8270D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D SIM	Naphthalene
GC/MS	EPA 8270D SIM	Phenanthrene
GC/MS	EPA 8270D SIM	Pyrene
GC/MS	EPA 8260C SIM	1,4- dioxane
GC-FID	EPA 8015B	Diesel Range Organics
GC-FID	EPA 8015B	Motor Oil Range Organics
GC-FID	EPA 8015B	TPH (as Diesel)
GC-FID	EPA 8015B	Gasoline Range Organics
GC-FID	EPA 8015B	Ethanol
GC-FID	EPA 8015B	Methanol
GC-FID	EPA 8015B	Ethylene glycol
GC-FID	EPA 8015B	Propylene glycol
LC/MS/MS	EPA 6850	Perchlorate
ICP-MS	EPA 6020A	Aluminum
ICP-MS	EPA 6020A	Antimony
ICP-MS	EPA 6020A	Arsenic
ICP-MS	EPA 6020A	Barium
ICP-MS	EPA 6020A	Beryllium
ICP-MS	EPA 6020A	Bismuth
ICP-MS	EPA 6020A	Boron
ICP-MS	EPA 6020A	Cadmium
ICP-MS	EPA 6020A	Calcium
ICP-MS	EPA 6020A	Cerium
ICP-MS	EPA 6020A	Cesium
ICP-MS	EPA 6020A	Chromium
ICP-MS	EPA 6020A	Cobalt
ICP-MS	EPA 6020A	Copper
ICP-MS	EPA 6020A	Hafnium

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP-MS	EPA 6020A	Iron
ICP-MS	EPA 6020A	Lanthanum
ICP-MS	EPA 6020A	Lead
ICP-MS	EPA 6020A	Lithium
ICP-MS	EPA 6020A	Magnesium
ICP-MS	EPA 6020A	Manganese
ICP-MS	EPA 6020A	Molybdenum
ICP-MS	EPA 6020A	Neodymium
ICP-MS	EPA 6020A	Nickel
ICP-MS	EPA 6020A	Niobium
ICP-MS	EPA 6020A	Palladium
ICP-MS	EPA 6020A	Phosphorus
ICP-MS	EPA 6020A	Platinum
ICP-MS	EPA 6020A	Potassium
ICP-MS	EPA 6020A	Praseodymium
ICP-MS	EPA 6020A	Rhodium
ICP-MS	EPA 6020A	Ruthenium
ICP-MS	EPA 6020A	Samarium
ICP-MS	EPA 6020A	Selenium
ICP-MS	EPA 6020A	Silicon
ICP-MS	EPA 6020A	Silver
ICP-MS	EPA 6020A	Sodium
ICP-MS	EPA 6020A	Strontium
ICP-MS	EPA 6020A	Sulfur
ICP-MS	EPA 6020A	Tantalum
ICP-MS	EPA 6020A	Technetium-99
ICP-MS	EPA 6020A	Tellurium
ICP-MS	EPA 6020A	Thallium
ICP-MS	EPA 6020A	Thorium
ICP-MS	EPA 6020A	Tin
ICP-MS	EPA 6020A	Titanium
ICP-MS	EPA 6020A	Tungsten
ICP-MS	EPA 6020A	Uranium
ICP-MS	EPA 6020A	Uranium 233
ICP-MS	EPA 6020A	Uranium 234
ICP-MS	EPA 6020A	Uranium 235

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Solid and Chemical Materials

Technology	Method	Analyte
ICP-MS	EPA 6020A	Uranium 236
ICP-MS	EPA 6020A	Uranium 238
ICP-MS	EPA 6020A	Vanadium
ICP-MS	EPA 6020A	Yttrium
ICP-MS	EPA 6020A	Zinc
ICP-MS	EPA 6020A	Zirconium
CVAA	EPA 7471B	Mercury
Colormetric	EPA 9010C EPA 9012B	Cyanide
Ion Chromatrography	EPA 300.0 EPA 9056A	Bromide
Ion Chromatrography	EPA 300.0 EPA 9056A	Chloride
Ion Chromatrography	EPA 300.0 EPA 9056A	Fluoride
Ion Chromatrography	EPA 300.0 EPA 9056A	Nitrate
Ion Chromatrography	EPA 300.0 EPA 9056A	Nitrite
Ion Chromatrography	EPA 300.0 EPA 9056A	Sulfate
Ion Chromatrography	EPA 300.0 EPA 9056A	Ortho-phosph
Ion Chromatrography	EPA 300.0 EPA 9056A	Iodide
Ion Chromatrography	EPA 314.0	Perchlorate
Gravimetric	SM 2540B SM 2540C SM 2540D	Solids
Probe	EPA 9040C EPA 9045D EPA 150.1	pH
Titration	SM 2320B EPA 310.1	Alkalinity
Titration	EPA 9030	Sulfide
Penske-Martin	EPA 1010A	Ignitability
Colormetric	EPA 353.1	nitrate/Nitrite
Colormetric	EPA 350.1	Ammonia
TOC Analyzer	EPA 9060A	TOC
Colormetric	EPA 7196A	Hex Chromium

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Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Gravimetric	EPA 1664A	Oil & Grease
Gravimetric	EPA 1664A	TPH
Probe	EPA 9050A	Conductivity
Gas Flow Proportional Counter	EPA 900.0 EPA 9310	gross alpha/beta
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	Radium-226
Gas Flow Proportional Counter	EPA 903.0 EPA 9315	total radium
Gas Flow Proportional Counter	EPA 904.0 EPA 9320	Radium-228
Gas Flow Proportional Counter	EPA 905.0 / DOE HASL 300 Sr-02	Strontium-90
Liquid Scintillation Counter	EPA 906.0	Tritium
Liquid Scintillation Counter	Eichrom Technologies TCW01/TCS01	Tecnetium-99
Liquid Scintillation Counter	EERF C-01-C14	Carbon-14
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Gamma Emitters:
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 227 (assumes equilibrium w/ Th-227)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Actinium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Americium 241
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 124
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Antimony 125
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium-137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium/Lanthanum-140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 133
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Barium 140
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Beryllium 7
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 211 eq Th-227

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Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 207
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth-210M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Bismuth 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Calcium-45
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 141
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 139
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cerium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 134
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cesium 137
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 57
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 58
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Cobalt 60
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 152
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 154
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Europium 155
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Hafnium 181
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iodine 131
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iridium 192
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Iron 59
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lanthanum 140

Solid and Chemical Materials

Technology	Method	Analyte
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 210
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 211
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 212
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Lead 214
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese-56
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Manganese 54
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Mercury 203
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 237
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Neptunium 239
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 83
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 94
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Niobium 95
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Potassium 40
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 144
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 146
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Promethium 147
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234M
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Protactinium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium (226)
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 223 (assumes equilibrium w/ Th-227)

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Solid and Chemical Materials

Technology	Method	Analyte
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Radium 224
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Ruthenium 106
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Scandium 46
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 22
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Sodium 24
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Strontium 85
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thallium 208
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 227
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 228
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 230
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 231
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 232
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Thorium 234
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Tin 113
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 235
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Uranium 238
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Vanadium-48
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Yttrium 88
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zinc 65
Gamma Spectroscopy	EPA 901.1 / DOE HASL 300 Ga-01-R	Zirconium 95
Alpha Spectroscopy	DOE HASL 300 A-01-R	Alpha spec analysis:
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Uranium

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Thorium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Americium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Plutonium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Neptunium
Alpha Spectroscopy	DOE HASL 300 A-01-R	Isotopic Curium
Liquid Scintillation Counter	Eichrom Technologies OTW01, OTS01	Lead-210
Alpha Spectroscopy	Laboratory SOP ST-RC-0210	Polonium-210
Liquid Scintillation Counter	DOE RP-300	Nickel 59/63
Liquid Scintillation Counter	SM 7500-IB	Iodine-129
Preparation	**Method**	**Type**
Organic Extraction & Sample Prep	EPA 3500C	Organic Extraction & Sample Prep
Volatile Prep	EPA 5000	Sample Preparation for Volatile Organic Compounds
Organic Cleanup	EPA 3600A	Cleanup for Organic extracts
Organic prep/analysis	EPA 8000C	Determinative Chromatographic Separations
Acid Digestion (Aqueous samples)	EPA 3010A	Acid Digestion for Metals (Aqueous samples)
Acid Digestion (solids)	EPA 3050B	Acid Digestion for Metals of Sedimtent/Soils
Purge & Trap	EPA 5030C	Purge & Trap for Aqueous Volatile Samples
Closed System Purge & Trap and Extraction for Volatiles	EPA 5035A	Closed System Purge & Trap and Extraction for Volatiles
Sep Funnel Liquid-Liquid Extraction	EPA 3510C	Sep Funnel Liquid-Liquid Extraction
Ultrasonic Extraction	EPA 3550C	Ultrasonic Extraction Organic Soils
Solid Phase Extraction	EPA 3535A	Solid Phase Extraction
Acid Clean-up	EPA 3665A	Acid Clean Up for PCBs
Florisil Cleanup	EPA 3620C	Florisil Cleanup
Sulfur Cleanup	EPA 3660B	Sulfur Cleanup
Waste Dilution	EPA 3585	Waste Dilution Volatile Organics

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Solid and Chemical Materials		
Preparation	**Method**	**Type**
Waste Dilution	EPA 3580A	Waste Dilution SemiVolatile Organics
TCLP Extraction	EPA 1311	TCLP Extraction
SPLP Extraction	EPA 1312	SPLP Extraction
CWET Extraction	CA Title 22	CWET Extraction
Alkaline Digestion	EPA 3060A	Alkaline Digestion for Hexavalent Chromium

Notes:

1) This laboratory offers commercial testing service.

Approved by: ______________________ Date: April 6, 2016

R. Douglas Leonard
Chief Technical Officer

Re-Issued: 4/6/16

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FOIA Exemption 4 (5 USC 552(b)(4))
Privileged / confidential trade secrets, commercial, financial information

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YOU MAY APPEAL THIS DECISION

Based on the redaction, this constitutes a partial denial of your request. Because your request has been denied in part, you are advised of your right to appeal this determination in writing.

Please refer to the accompanying correspondence from the FOIA Office for directions and information about the appeal process.

Appendix B
Contractor Quality Control Plan

Naval Facilities Engineering Command Southwest
BRAC PMO West
San Diego, CA

APPENDIX B
FINAL
CONTRACTOR QUALITY CONTROL PLAN

Parcel F Structures

HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

July 2018

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DCN: APTM-0006-4550-0025

Naval Facilities Engineering Command Southwest
BRAC PMO West
San Diego, CA

APPENDIX B
FINAL
CONTRACTOR QUALITY CONTROL PLAN

Parcel F Structures

HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

July 2018

Prepared for:

Department of the Navy
Naval Facilities Engineering Command Southwest
BRAC PMO West
33000 Nixie Way, Bldg. 50
San Diego, CA 92147

Prepared by:

Aptim Federal Services, LLC
4005 Port Chicago Highway, Suite 200
Concord, CA 94520

Contract Number: N62473-17-D-0006; Task Order: N62473-17-F-4550
DCN: APTM-0006-4550-0025

Naval Facilities Engineering Command Southwest
BRAC PMO West
San Diego, CA

APPENDIX B
FINAL
CONTRACTOR QUALITY CONTROL PLAN

Parcel F Structures

HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

July 2018

Approved By:	Steve Massey Program Quality Control Manager	July 3, 2018 Date
Approved By:	Lisa Bercik, PE, QSD, QSP Project Manager	July 3, 2018 Date

Contract Number: N62473-17-D-0006; Task Order: N62473-17-F-4550
DCN: APTM-0006-4550-0025

Table of Contents

Table of Contents (continued)

List of Attachments

Acronyms and Abbreviations

APP/SSHP	*Accident Prevention Plan/Site Safety and Health Plan, Radiological Work Tasks, Remedial Action and Maintenance of Remedies at Hunters Point Naval Shipyard, San Francisco, California*
AMS	*APTIM Management System*
APTIM	Aptim Federal Services, LLC
COR	Contracting Officer Representative
CQC	contractor quality control
CTO	contract task order
DFOW	definable feature of work
KO	Contracting Officer
Navy	U.S. Department of the Navy
PM	project manager
QC	quality control
QCD	quality control directive
RPP	*Radiation Protection Plan, Radiological Work Tasks, Remedial Action and Maintenance of Remedies at Hunters Point Naval Shipyard, San Francisco, California*
WP	work plan

1.0 Introduction

Aptim Federal Services, LLC (APTIM) prepared this Contractor Quality Control (CQC) Plan under Contract No. N62473-17-D-0006, Contract Task Order (CTO) N62473-17-F-4550 to describe the quality control (QC) actions that will be implemented during the radiological characterization surveys at Parcel F, Hunters Point Naval Shipyard, San Francisco, California. This CQC Plan will be used in conjunction with the following:

- *Corporate Quality Management Plan, Environmental Multiple Award Contract for Remediation of Radiological Contaminants (RADMAC II)* (CB&I Federal Services LLC, 2017), which includes quality control directives (QCDs)
- *APTIM Management System* (AMS; APTIM, 2017a)

Radiological activities will include radiological characterization surveys of the Parcel F structures (submarine pens and finger piers). Radiological work will be performed in accordance with U.S. Nuclear Regulatory Commission Radioactive Materials License 20-31340-01, and State of California Radioactive Materials License 7789-07 and associated procedures and work instructions. Radiological safety procedures and roles and responsibilities of the radiological organization are described in the *Radiation Protection Plan, Radiological Work Tasks, Remedial Action and Maintenance of Remedies at Hunters Point Naval Shipyard, San Francisco, California* (RPP; APTIM, 2017b).

This project-specific CQC Plan was developed to ensure project activities are conducted in a planned and controlled manner; the product of these activities conforms to contract requirements; and appropriate documentation exists to support each activity for which APTIM is responsible.

A Project QC Manager will be present at the work site to implement and manage the QC Program. The Project QC Manager will work closely with the Project Manager (PM) and with the U.S. Department of the Navy (Navy) quality assurance representatives to assure that the work is performed in compliance with specifications contained in the work plan (WP) and this CQC Plan. The Project QC Manager has the authority to stop work if contract requirements are not being met. In the event that the Project QC Manager is unavailable, an alternate QC Manager will assume this responsibility.

The Program QC Manager for this Navy contract is responsible for developing, maintaining, and enforcing the QC Program for the contract, and will work directly with the PM and the Project QC Manager to assure that all work is performed in compliance with the contract. The Program QC Manager will serve as an alternate contact for the Project QC Manager if questions arise regarding acceptability of materials or performance during the project.

The PM reports to the Program Manager for the contract, who has the responsibility and authority to ensure that the work is performed according to the approved specifications and to the Navy's satisfaction.

Attachment 1 depicts APTIM's project organization for this CTO. Attachments 2 through 9 are documents from the QCDs tailored to this CTO, which will help achieve statement CTO objectives. If additional project-specific quality procedures are required as the project progresses, these procedures will be inserted into Attachment 10.

2.0 Quality Control Organization

APTIM structured its corporate QC organization to support the Program Managers and PMs who have ultimate responsibility for the quality of services APTIM provides. The Program Managers and PMs are responsible for ensuring that personnel in their organizations understand the corporate and contract-specific QC programs and that their organizations' functions are set up and maintained effectively.

Quality issues are resolved at the lowest possible organizational level at each project site, to enable timely correction action development and implementation. Issues that cannot be satisfactorily resolved at the project level are elevated to and resolved at the corporate level.

APTIM's project organization chart, including QC personnel, is shown in Attachment 1. The figure illustrates the reporting and communication relationships between QC personnel, the APTIM field team, subcontractors, and Navy representatives. This structure provides the organizational freedom for personnel to identify and evaluate quality problems and discrepancies, provide recommended solutions, and ensure that appropriate corrective actions are taken.

The specific responsibilities and qualifications associated with each QC-related position are outlined in Attachment 2. The qualifications and experience of the proposed key appointees for this project are summarized in Attachments 3 and 4.

2.1 Quality Control Personnel and Qualifications

Key QC personnel for APTIM projects are assigned on the basis of appropriate experience and the determination that these individuals meet the contract and CTO-specific requirements. The Project QC Manager and Alternate Project QC Manager are appointed by the Program QC Manager. The following paragraphs identify the QC team for this CTO and highlight their responsibilities. Copies of appointees' resumes, certifications, and letters of designation are included in Attachments 3 and 4.

2.1.1 Project Quality Control Manager

The Project QC Manager, who reports directly to the Program QC Manager, will work closely with the PM, Radiation Safety Officer, Radiation Control Supervisor, and Navy QC representatives to assure that the work is performed in compliance with the specifications contained in the approved WP. The Project QC Manager has the authority to stop work if contract requirements are not being met. The Project QC Manager's responsibilities are listed in Attachment 2. In the event the Project QC Manager is unavailable, an Alternate Project QC Manager will assume this responsibility.

2.1.2 Alternate Project Quality Control Manager

In the event the Project QC Manager is unavailable, an Alternate Project QC Manager will assume the QC responsibilities outlined in Attachment 2 and described in this CQC Plan. The Alternate Project QC Managers designated for this project are identified in Attachment 4.

The project team, including subcontractors, will use procedures in this subsection to ensure quality and achieve project objectives.

2.2 Quality Control Directives

The following QCDs apply to this CTO:

- QCD 1.0, "Project Quality Control Personnel Duties, Qualifications, and Authority"
- QCD 2.0, "Project Quality Control Plans"
- QCD 3.0, "Design Review"
- QCD 4.0, "Coordination and Mutual Understanding Meeting"
- QCD 5.0, "Project Quality Control Meetings"
- QCD 6.0, "Submittals"
- QCD 7.0, "Documentation"
- QCD 8.0, "Quality Control Certifications"
- QCD 9.0, "Three Phases of Control"
- QCD 10.0, "Completion Inspections"
- QCD 11.0, "Testing"
- QCD 12.0, "Corrective Action Requests and Non-compliance"
- QCD 13.0, "Rework"
- QCD 14.0, "Change Control"
- QCD 15.0, "Organization and Personnel Certifications Log"
- QCD 16.0, "Field Startup"
- QCD 17.0, "PM Turnover"
- QCD 18.0, "Training"
- QCD 19.0 "Quality Audits"
- QCD 20.0 "Quality Control for Geophysical Surveys"

2.3 APTIM Quality Procedures

The following documents describe the administrative and technical requirements for uniform quality performance for this project. These procedures are developed, maintained, and hosted corporately within the AMS. Procedures can be accessed by any APTIM employee and will be provided to the government upon request (APTIM, 2017a).

- AMS-720-01-PR-00130, “Quality Management Organization” (supersedes EIP-Q-001, “Quality Organization”)
- EIP-Q-002, “Stop Work Notice for Quality Related Issues” (no current AMS equivalent)
- AMS-720-01-PR-00120, “Project Quality Plans” (supersedes EIG-Q-003, “Project Quality Plan”)
- AMS-720-02-PR-00480, “Receiving Inspection” (supersedes EIP-Q-004, “Receipt Inspection”)
- AMS-720-01-PR-00230, “Construction Inspection Program” (supersedes EIP-Q-005, “Inspection”)
- AMS-720-01-PR-00290, “Inspection and Test Plans” (supersedes EIP-Q-005, “Inspection” and EIP-Q-016, “Test Control”)
- AMS-720-01-GL-00230, “Guidelines for Quality Surveillance Activities” (supersedes EIP-Q-006, “Surveillance”)
- AMS-720-01-PR-00150, “Identification, Control, and Disposition of Nonconforming Product” (supersedes EIG-Q-007, “Nonconformance Reporting”)
- AMS-720-01-PR-00170, “Corrective and Preventive Action” (supersedes EIG-Q-008, “Corrective Action”)
- AMS-720-01-PR-00220, “Management System Audits” (supersedes EIG-Q-009, “Quality Audits”)
- AMS-720-01-GL-00223, “Qualification and Assessment of Internal Audit Personnel” (supersedes EIP-Q-010, “Auditor and Lead Auditor Qualification Program”)
- EIP-Q-014, “Management Assessment” (no current AMS equivalent)
- EIG-Q-015, “Quality Councils” (no current AMS equivalent)

Note: The QCDs take precedence over these procedures

3.0 Outside Organizations

To manage subcontractors and vendors effectively, APTIM carefully selects and prequalifies each firm. APTIM continuously and aggressively manages subcontractor costs, schedule, safety, and quality performance. The pre-qualification process ensures that subcontractors bring the same focus on quality, cost control, schedule discipline, and commitment to customer satisfaction as APTIM. Once an award is made to a subcontractor, APTIM manages the quality of the subcontractor's performance through the three-phase inspection process outlined in Section 9.0.

Laboratories providing environmental analyses are accredited as noted in the Sampling and Analysis Plan prepared under this same contract for Parcel F (Appendix A of the WP).

Names and qualifications of subcontractors proposed for this project are summarized in Attachment 5. Subcontractors will be subject to APTIM QC procedures. Testing and inspection procedures will be monitored by APTIM as described in Section 5.0.

4.0 Submittal Procedures

Submittals will be managed by APTIM as required by contract. The Project QC Manager will review and approve items prior to submittal. The Project QC Manager will certify that submittals are in compliance with contract requirements. Radiological data will be reviewed by the Project Radiation Safety Officer or designee prior to submittal. Submittals are further discussed under QCD 6.0.

5.0 Testing

In addition to implementing the three phases of the control system to ensure the overall quality of each definable feature of work (DFOW), APTIM will make use of formal testing procedures where applicable, including tests performed by subcontractors and/or off-site laboratories, to ensure conformance to applicable specifications and verify that control measures are adequate to provide a finished product which conforms to contract requirements. The Project QC Manager will ensure that sampling and testing are managed and performed as required by contract.

5.1 Testing Plan and Log

If necessary, the Project QC Manager will use the Testing Plan and Log, contained in Attachment 7, to manage project testing. As tests are performed, the Project QC Manager will record on the log the date the test was performed and the date the test results were forwarded to the Contracting Officer (KO) or Contracting Officer Representative (COR) as applicable. The Project QC Manager will attach a copy of the updated log to the last Daily Contractor QC Report of each month. Chemical or radiological sampling and analyses are normally not included in the log, since requirements are implemented by the Sampling and Analysis Plan (Appendix A of the WP).

5.2 Testing and Documentation

APTIM will submit test reports, containing test results to the KO and/or COR as required by contract. Test reports will cite applicable contract requirements, tests or analytical procedures used, and include a statement that the item tested or analyzed conforms or fails to conform to specified requirements. If the item fails to conform, APTIM will notify the KO and/or COR immediately. APTIM will submit the signed test reports, certifications, and other documentation to the KO and/or COR via the Project QC Manager. The Project QC Manager shall submit a summary report of field tests in the Daily Contractor QC Report. Testing is further discussed under QCD 11.0.

6.0 Rework Items, Non-Compliances, and Corrective Action Requests

The Project QC Manager will review any instances where materials, equipment, or activities fail to meet the specified requirements, and will take appropriate action to prevent future occurrences.

6.1 Rework

A rework item is work that does not comply with the contract. There is no requirement to report a rework item that is corrected the same day it is discovered. All APTIM and subcontractor personnel will be responsible for identifying rework items and reporting them to the Project QC Manager. The Project QC Manager will coordinate with the Project Superintendent to ensure rework items are corrected in a timely manner. The Project QC Manager shall maintain a Rework Items List of work that does not comply with the contract, including those identified by the KO or his/her representative. The Project QC Manager will report identified and corrected items in the Daily Contractor QC Report and during Project QC Meetings and will attach a copy of the Rework Items List to the last Daily Contractor QC Report of each month. Rework items are further discussed under QCD 13.0.

6.2 Non-Compliances

The KO may also notify APTIM of any detected non-compliance with the contract. APTIM will take immediate corrective action after receipt of such notice. Such notice, when delivered to APTIM at the work site, shall be deemed sufficient for the purpose of notification. Non-compliances are further discussed under QCD 12.0.

6.3 Corrective Action Requests

APTIM will identify, track, and correct items, processes, and services that do not meet established requirements. Correction will focus on determining the cause of the deficiency and corrective actions will address the deficiency and prevent recurrence. Corrective Action Requests are further discussed under QCD 12.0.

6.4 Procedures for Tracking Laboratory Deficiencies

Laboratory testing requirements for radiological analyses and procedures for identifying and managing any deficiencies are addressed under the Sampling and Analysis Plan (Appendix A of the WP).

7.0 Documentation

A variety of documents will be developed at specified points or intervals during the course of this project to support the QC process. These items will be submitted to the government or maintained by APTIM and made available for review as required. QC-related project documentation may include:

- Testing plan and log
- Daily CQC reports
- Three-phase control inspection checklists (preparatory, initial, and follow-up)
- QC meeting minutes
- Rework items list
- Non-compliance/corrective action reports
- As-built drawings
- Material receipt inspections

Documentation is further discussed under QCD 7.0.

7.1 Daily Reports

APTIM shall submit reports for each day that work is performed as required by contract. Reports will be attached to the Daily Contractor QC Report. Reports may also be submitted on a weekly basis depending on the nature of work and with approval from the Navy. The reporting of work shall be identified by terminology consistent with the construction schedule. The “remarks” section of reports will include directions received, construction deficiencies and problems, QC problems, deviations from project plans, conflicts or errors in the drawings or specifications, field changes, instructions given and corrective actions taken, work progress and delays, safety hazards, meetings held, and visitors to the work site.

7.1.1 Daily Contractor Quality Control Report

The Project QC Manager is responsible for preparing and signing the Daily Contractor QC Report. Other QC, production, and health and safety documents may be attached to this report. The Project QC Manager will submit the report to the Navy by 10:00 AM the next working day after each day that work is performed and for every seven consecutive calendar days of no-work.

7.1.2 Daily Contractor Production Report

The Project Superintendent or designee is responsible for preparing and signing the Daily Contractor Production Report. The report will be attached to the Daily Contractor QC Report.

7.1.3 Quality Control Specialist Report

If a QC Specialist is assigned, he/she shall prepare, sign, and date a report for each day that work is performed in his/her area of responsibility. This report shall include the same documentation requirements as are submitted with the Daily Contractor QC Report.

7.2 Quality Control Meeting Minutes

After the start of construction, the Project QC Manager will commence holding weekly QC meetings with the Site Superintendent, QC staff, and Site Safety and Health Officer. The Navy Remedial Project Manager/COR, Caretaker Site Office, Resident Officer in Charge of Construction, and Radiological Affairs Support Office may also attend these meetings as required.

As a minimum, the following will be accomplished at each QC meeting as needed:

- Review the minutes of the previous meeting
- Review the status of work, inspections, testing, rework, and submittals
- Review the work, inspections, and testing to be accomplished in the next two weeks and documentation required
- Resolve QC, production, and safety concerns
- Address items that may require revising the project plans
- Review the accident prevention plan and/or activity hazard analyses as necessary
- Review environmental requirements and procedures as necessary
- Review the following, as applicable
  - Waste Management Plan
  - Radiological Protection Plan
  - Status of training completion and progress

The Project QC Manager will prepare the minutes of the meetings and provide a copy to the COR within two working days after the meeting.

7.3 Quality Control Validation

APTIM shall maintain files of original documents in a home office, including project documents. Copies of project documents will also be filed in the field office. Project files include, but are not limited to, inspection reports and checklists, Testing Plan and Log, Rework Items List, and punch lists. Reports are required from the QC Specialists (if assigned) for each day that work is performed in their area of responsibility. QC Specialist reports shall include the same documentation requirements as the Daily Contractor QC Report for their area of responsibility. QC Specialist reports are to be prepared, signed, and dated by the QC Specialists and shall be attached to the Daily Contractor QC Report prepared for the same day.

7.4 As-Built Drawings

The Project QC Manager shall ensure the as-built drawings are kept current on a daily basis and marked to show deviations from the contract drawings identified with the appropriate modifying documentation. The Project QC Manager or QC Specialist assigned to that area of responsibility shall initial each revision. Upon completion of work, the Project QC Manager will certify the drawings, attesting to their accuracy, and ensure that they are submitted to the KO per QCD 8.0.

8.0 Definable Features of Work

A DFOW is a representative portion of work that is separate and distinct from any other stage of work. Three DFOWs have been identified for this project, as outlined in the following subsections and further described in the WP. Activities associated with the project will be conducted in accordance with the WP and Sampling and Analysis Plan (Appendix A of the WP); the *Accident Prevention Plan/Site Safety and Health Plan, Radiological Work Tasks, Remedial Action and Maintenance of Remedies at Hunters Point Naval Shipyard, San Francisco, California* (APP/SSHP; APTIM, 2017c); and the RPP (APTIM, 2017b) for this project, which provide specific methods and requirements for implementation of the DFOWs.

8.1 Definable Feature of Work 1: Radiological Surveys of Parcel F Structures

Class 3 *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, (U.S. Nuclear Regulatory Commission et al., 2000) surveys of the Parcel F submarine pens and finger piers will be completed. Per the CTO project work statement, the survey will include six Class 3 survey units, one survey unit for each pier and submarine pens. The characterization surveys will be completed so that if contamination is not found, the characterization survey will be presented as a final status survey to achieve unrestricted release.

The gamma scan surveys will be performed for 100 percent of the accessible areas using the RS-700 or a Ludlum Model 44-20 3-inch by 3-inch sodium iodide gamma scintillation detector coupled with a Ludlum Model 2221 ratemeter/scaler (or equivalent) handheld instrument in areas inaccessible to the RS-700, consistent with the requirements for a *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, survey (U.S. Nuclear Regulatory Commission et al., 2000). The objective of the gamma scan surveys is to identify areas of elevated gamma radioactivity that could result from residual radioactivity from radioluminescent devices or other sources of gamma radiation. Areas of elevated gamma activity will be included in the areas covered by the alpha and beta scan surveys.

Alpha/beta static measurements and alpha/beta swipes will be collected over 25 percent of the accessible areas of the Parcel F structures. The alpha/beta static measurements will be performed using portable contamination survey instruments specifically, the Ludlum Model 43-37 gas flow proportional “floor monitor” detector or Ludlum Model 43-93 zinc sulfide/plastic scintillator detector (or equivalent) coupled with a Ludlum Model 2360 scaler/ratemeter (or equivalent). The scaler/ratemeter will be set to a two-minute count time. At the start of each measurement, the surveyor will position the detector, and begin the two-minute count. At the completion of each two-minute count, the alpha and beta result will be recorded. The IL for the static alpha and beta will be developed and used as described in the decision rules included in the WP. The release criteria were established in the *Final Basewide Radiological Removal Action, Action Memorandum - Revision 2006, Hunters Point Shipyard, San Francisco, California* (Navy, 2006).

Samples (sediment, wood, or concrete) may be collected as required to support the radiological characterization surveys.

8.2 Definable Feature of Work 2: Decontamination and Release of Equipment and Tools

Equipment and personnel exiting a work area will follow decontamination procedures presented in the APP/SSHP (APTIM, 2017c). Decontamination areas will be located near work boundary exits. The level of decontamination of equipment will be determined by the Site Health and Safety Officer and Project Radiation Safety Officer. The need for and degree of decontamination will be based on the characteristics of the material within the work area and the potential for transporting contaminants outside of the work area.

Visible dirt or debris will be removed from equipment with a brush and a Masslin wipe. The equipment and wipe will be surveyed to confirm the absence of activity above applicable control levels as described in the RPP (APTIM, 2017b) using the surface contamination criteria from the *Final Basewide Radiological Removal Action, Action Memorandum - Revision 2006, Hunters Point Shipyard, San Francisco, California* (Navy, 2006). Detectable levels of activity during decontamination above criteria will require immediate notification to the Navy for further direction.

8.3 Definable Feature of Work 3: Site Restoration/Demobilization

Restoration of Parcel F structures following the characterization survey effort is not expected or required. Any surface sample locations (i.e., core borings) will be restored in kind with concrete patching to prevent further weathering/destruction of the area sampled.

9.0 Three Phases of Control

The Project QC Manager manages the three phases of control to adequately cover on-site and off-site DFOWs. The Project QC Manager may assign the Task Leader for DFOWs to other project personnel, including the Project Engineer, Project Geologist, Project Superintendent, QC Specialist, etc.

9.1 Preparatory Phase

The Project QC Manager shall notify the CO and/or COR, as applicable, at least two work days, two weeks for off-site work, in advance of each preparatory phase meeting. The assigned lead shown on the project DFOW Matrix will conduct the meeting. At a minimum, the Project QC Manager, QC staff, Project Superintendent, foreman, and Site Safety and Health Officer will attend. When a subcontractor will perform work, that subcontractor's superintendent shall attend.

9.1.1 Preparatory Phase Activities

The following will occur during the preparatory phase:

- Review each paragraph of the applicable specification sections.
- Review the contract drawings.
- Verify that field measurements are as indicated on construction and/or shop drawings before confirming product orders, in order to minimize waste due to excessive materials.
- Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and approved. Verify receipt of approved factory test results, when required.
- Review the Testing Plan and Log, and ensure that provisions have been made to provide the required QC testing.
- Examine the work area to ensure that the required preliminary work has been completed.
- Coordinate the schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- Examine the required materials, equipment, and sample work to ensure that they are on hand and conform to the approved shop drawings and submitted data.
- Discuss construction methods, construction tolerances, workmanship standards, and the approach that will be used to provide quality construction by planning ahead and identifying potential problems.

- Review the APP/SSHP (APTIM, 2017c) and appropriate activity hazard analyses to ensure that applicable safety requirements are met and that required material safety data sheets are submitted.

Results of the preparatory phase will be documented in the Inspection Report and attached to the Daily Contractor QC Report.

9.2 Initial Phase

The Project QC Manager shall notify the KO and/or COR at least two work days, two weeks for off-site work, in advance of each initial phase. The assigned lead shown on the project DFOW Matrix will perform the initial phase and he/she will observe the initial segment of the DFOW to ensure that the work complies with contract requirements. Results of the initial phase will be documented in the Inspection Report and attached to the Daily Contractor QC Report. Attachments contain this report. The following will be performed:

- Establish the quality of workmanship required
- Resolve conflicts
- Ensure that testing is performed by the approved laboratory
- Check work procedures for compliance with the APP/SSHP (APTIM, 2017c) and the appropriate activity hazard analyses to ensure that applicable safety requirements are met

Results of the initial phase will be documented in the Inspection Report and attached to the Daily Contractor QC Report.

9.3 Follow-up Phase

The assigned lead shown on the project DFOW Matrix will perform the follow-up phase for ongoing work daily, or more frequently as necessary, until the completion of the work. Results of the initial phase will be documented in the Inspection Report and attached to the Daily Contractor QC Report. The following will be performed:

- Ensure the work is in compliance with contract requirements
- Maintain the quality of workmanship required
- Ensure that testing is performed by the approved laboratory
- Ensure that rework items are being corrected
- Perform safety inspections

9.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases will be conducted for a deficiency if the quality of ongoing work remains or becomes unacceptable; there are changes in the applicable QC organization; there are changes in the on-site production supervision or work crew; work is resumed after substantial period of inactivity; or other problems develop. The three phases of control are further discussed under QCD 9.0.

10.0 Completion Inspections

Project inspections that demonstrate completeness are described in this section. Inspections may include a punch-out inspection, pre-final inspection, and final acceptance inspection.

10.1 Punch-Out Inspection

The Project QC Manager will manage completion inspections. Near the completion of all work or to verify that statement of objectives or performance work statements are met, the Project QC Manager will ensure work is inspected and a punch list developed. Punch list items include items that do not conform to the approved drawings, specifications and contract, and remaining rework items. The punch list will indicate the estimated correction dates of these items. A copy of the punch list will be provided to the COR, if required by contract. The Project QC Manager will ensure corrected items are verified. Once this is accomplished, he/she will schedule a pre-final inspection.

10.2 Pre-Final Inspection

The Navy will perform a pre-final inspection to verify that fieldwork is complete. A Navy punch list may be developed as a result of this inspection. The Project QC Manager will ensure that the items on this list are corrected prior to notifying the Navy that a final inspection with the client can be scheduled. Any items noted during the preliminary-final inspection must be corrected in a timely manner and be accomplished before the contract completion date for the work.

10.3 Final Acceptance Inspection

If required by contract, the Project QC Manager will notify the KO and/or COR at least 14 calendar days prior to the date a final acceptance inspection can be held, stating that all items previously identified during the pre-final will be corrected and acceptable, along with any other unfinished contract work, by the date of the inspection. The Project QC Manager, Project Superintendent, and others deemed necessary will be present during the inspection with the Navy. If deficiencies remain or are identified during the inspection, the parties will agree on a course of action. Completion inspections are further discussed under QCD 10.0.

10.4 Inspection Documentation

Inspection records will be maintained by the Project QC Manager in accordance with QCD 7.0.

11.0 References

CB&I Federal Services LLC, *2017, Corporate Quality Management Plan, Environmental Multiple Award Contract for Remediation of Radiological Contaminants (RADMAC II)*, May.

Aptim Federal Services, LLC (APTIM), 2017a, *APTIM Management System*.

APTIM, 2017b, *Radiation Protection Plan, Radiological Work Tasks, Remedial Action and Maintenance of Remedies at Hunters Point Naval Shipyard, San Francisco, California.*

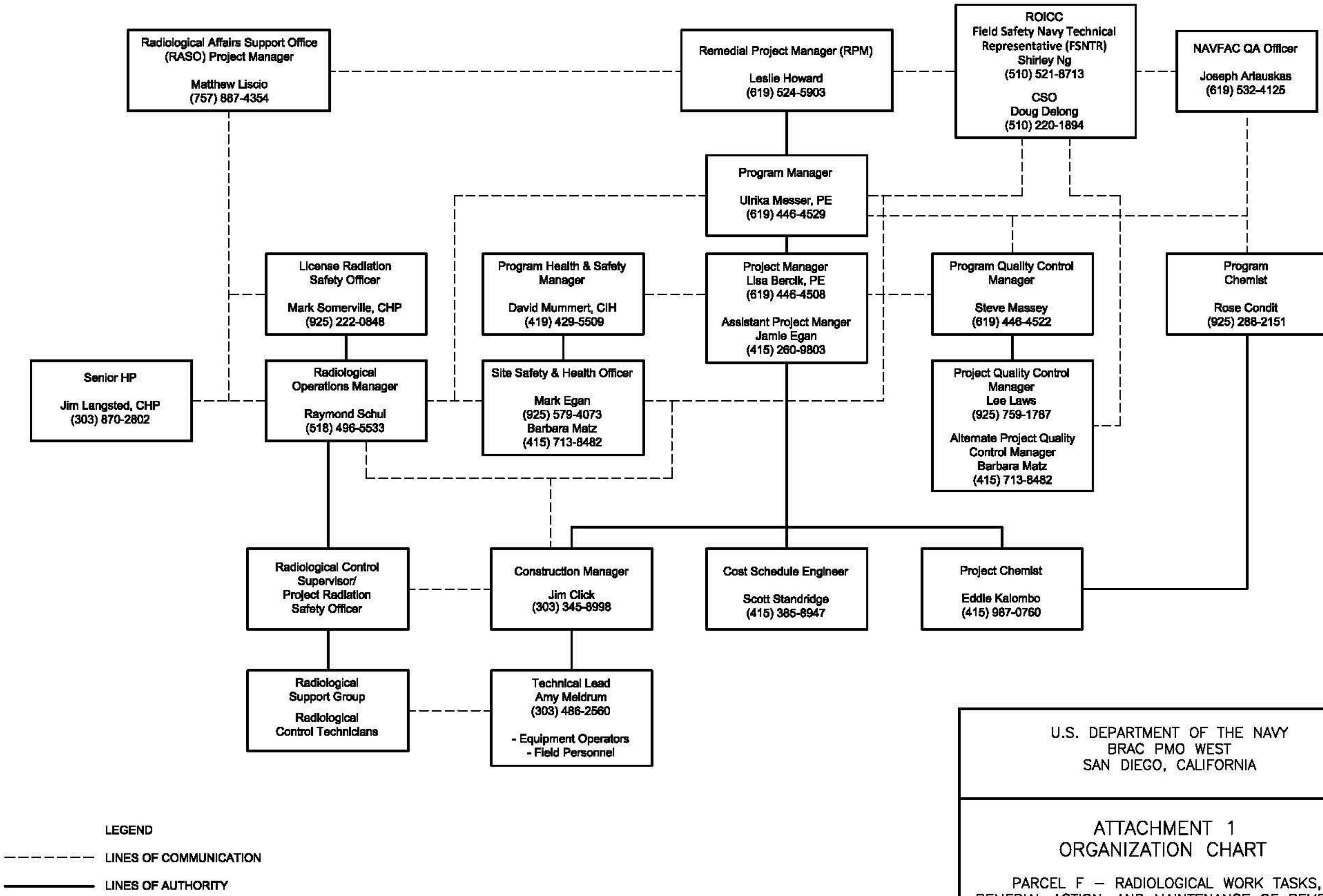
APTIM, 2017c, *Accident Prevention Plan/Site Safety and Health Plan, Radiological Work Tasks, Remedial Action and Maintenance of Remedies at Hunters Point Naval Shipyard, San Francisco, California.*

U.S. Department of the Navy (Navy), *Final Basewide Radiological Removal Action, Action Memorandum - Revision 2006, Hunters Point Shipyard, San Francisco, California,* April 21.

U.S. Nuclear Regulatory Commission, U.S. Environmental Protection Agency, and U.S. Department of Energy, 2000, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, NUREG-1575, EPA 402-R-97-016, DOE/EH-0624, Revision 1, Washington, D.C.

Attachment 1
Quality Control Organization Chart

IMAGE	X-REF	OFFICE	DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER	501008-A3
---	---	Concord	JWR	01/18/18						



U.S. DEPARTMENT OF THE NAVY
BRAC PMO WEST
SAN DIEGO, CALIFORNIA

ATTACHMENT 1
ORGANIZATION CHART

PARCEL F – RADIOLOGICAL WORK TASKS, REMEDIAL ACTION, AND MAINTENANCE OF REMEDIES
HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

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Attachment 2
Project Quality Control Duties and Responsibilities

Project Quality Control Duties and Responsibilities

Duty	Responsibility	QCD
Pre-Construction Phase		
Establish Personnel Requirements	PM	1.0
Review Personnel Resumes	PM	1.0
Assign Duties	PM	1.0, 2.0
Prepare Organization Chart	PQCM	1.0, 2.0
Prepare Letters of Designation	PQCM	1.0, 2.0
Review Plans and Designs	PM, PQCM	3.0, 7.0
Identify Subcontractors	PM	1.0, 2.0
Submit Laboratory Information	PQCM	1.0, 2.0
Attend Training	all	1.0
Prepare Submittal Register	PQCM	2.0, 6.0
Prepare Definable Features of Work Matrix	PQCM	2.0, 9.0
Prepare Testing Plan and Log	PQCM	2.0, 11.0
Prepare Rework Items List	PQCM	2.0, 13.0
Assemble Forms	PQCM	2.0
Assemble Personnel Certifications	PQCM	8.0, 15.0
Conduct Coordination and Mutual Understanding Meeting	PQCM	4.0
Construction Phase		
Ensure Construction Quality	PM	1.0, 14.0, 16.0, 17.0
Review Definable Features of Work	PQCM	9.0
Ensure Submittals Approved and Submitted	PQCM	3.0, 6.0, 7.0
Conduct Project QC Meetings	PQCM	5.0
Conduct Preparatory Meetings	PQCM	9.0
Conduct Preparatory Inspections	PQCM	9.0
Conduct Initial Inspections	PQCM	9.0
Conduct Follow-Up Inspections	PQCM	9.0
Conduct Completion Inspections	PQCM	10.0
Manage Corrective Action Requests	PQCM	12.0
Manage Rework Items	PQCM	13.0
Provide QC Certifications	PQCM	8.0

Notes:
The PQCM may assign the lead for inspections to the other project personnel: Task Lead, Project Site Superintendent, etc.

PM — *project manager*
PQCM — *project quality control manager*
QC — *quality control*
QCD — *quality control directive*

Attachment 3
Project Quality Control Manager Letter of Designation, Resume, and Construction Quality Management Training Certificate

CONTRACTOR QUALITY CONTROL PLAN—PARCEL F
Radiological Work Tasks, Remedial Action and Maintenance of Remedies
Hunters Point Naval Shipyard
San Francisco, California
Contract Number N62473-17-D-0006
Contract Task Order N62473-17-F-4550

PROJECT QUALITY CONTROL MANAGER
LETTER OF DESIGNATION

July 3, 2018

Mr. Lee Laws:

This letter will serve to assign you as the Aptim Federal Services, LLC Project Quality Control (QC) Manager for the above-captioned contract task order. In this capacity, you will report directly to me and will administer the established requirements of the contract and Project QC Plan. In the case where you are not able to perform the Project QC Manager's duties, Mr. Mark Vennemeyer, Ms. Barbara Matz, Mr. Kevin O'Leary, Mr. Michael Lightner, Ms. Amy Meldrum will serve as your Alternate Project QC Manager. You will manage the three phases of control. You are authorized to stop work that is not in accordance with the contract and will exercise this authority consistent with Aptim Federal Services, LLC policies and procedures. You are authorized to approve submittals that have been certified by qualified submittal reviewers as identified in the organization chart for this task order and as necessary to ensure the quality of the work, and direct the removal and/or replacement of nonconforming materials or work.

If you have any questions or require additional information, please contact me at 619.446.4552.

Sincerely,

Aptim Federal Services, LLC

Stephen P. Massey

Stephen Massey
Program QC Manager

Lee H. Laws

Professional Qualifications

Mr. Laws has more than 16 years of QA/QC experience with IT Corporation and The Shaw Group (May 2002 - Present), functioning since 1996, as Project QC Manager on the Navy EFA West Remedial Action Contract (RAC). This project experience has encompassed all phases of CERCLA Removal and Remedial Action cleanups, Superfund and National Priority List (NPL) sites, and numerous petroleum cleanups (e.g., USTs, ASTs) at federal facilities, industrial and residential properties under contracts from the U.S. Navy, U.S. Army Corps of Engineers (USACE), and U.S. Department of Energy (DOE).

Since 1999, Mr. Laws has served as the Lead QC Manager at Naval Station Treasure Island/Yerba Buena Island, which is a top priority Base Realignment and Closure (BRAC) base on the $250M Navy EFA West RAC. During this time period, the project backlog has grown to 16 environmental cleanup Contract Task Orders (CTO's 006, 012, 016, 036, 039, 040, 043, 045, 046, 089, 099, 102, 105, 106, 131, 134) with a total budget of over $37M, including a current backlog of over $20M. Treasure Island CERCLA, RCRA and petroleum cleanup projects have been executed with a high degree of involvement and oversight from the Navy, City of San Francisco, State and County regulatory agencies and local citizen groups who occupy the impacted property.

In support of this growing basewide cleanup program, Mr. Laws has prepared all CTO QC plans, provided ongoing project team and subcontractor coordination of task-specific QC inspections (including interface with two Government QA Resident Officers in Charge of Construction), and maintained all project QC documentation in a cost-effective MS-Access database. Mr. Laws produces project deliverables, including QC records and technical reports, in Adobe (pdf) format on CD-ROM, which substantially reduces project cost. Navy EFA West RAC six-month performance evaluations have consistently rated the Treasure Island QC Program "Level 1 - Outstanding," which has translated into an additional $1,664,316 of award fee profit (to-date) to IT Corporation and The Shaw Group

Education

High School Diploma, General Education, Pittsburg High Schol, Pittsburg, California, [redacted]

Additional Training/Continuing Education

USACE CQM Training, Sacramento, 2004
DHS Lead Supervisor/Monitor, UC Berkeley, [redacted]

Registrations/Certifications/Licenses

USACE Construction Quality Control Manager, 2004, Active, Nationwide, 11/2008

Experience and Background

05/2002 - Present
Project QC Manager, Shaw Environmental & Infrastructure, Inc., Quality, Concord, California

2002 - Present IT Corporation/Shaw Environmental & Infrastructure, Concord, California. Project QC Manager on the Navy Engineering Field Activity (EFA) West, Remedial Action Contract (RAC)

Naval Station Treasure Island, San Francisco, California.

Currently serve as the Lead QC Manager. Responsible for the planning, development and project team implementation of Project QC Plans and documentation on 10 environmental cleanup contract task orders with a total budget of over $37M. Projects involve the design, construction, operation, optimization and maintenance of remediation action systems (e.g., Soil Vapor Extraction); soil sampling, analysis, excavation, treatment, transportation and disposal; and site restoration in sensitive public housing areas. Mr. Laws effectively plans, coordinates and verifies task-specific QC inspections with Task Leaders, the Site Health & Safety Officer, Navy Resident Officers in Charge of Construction (ROICCs) and subcontractors. Mr. Laws also performs independent quality assurance audits, surveillances, and inspections of laboratories and field project activities to verify compliance with established QA program requirements

10/1996 - 05/2002
Project QC Manager, IT Corporation, Martinez, California

1996 - 2002 IT Corporation/Shaw Environmental & Infrastructure, Concord, California. Project QC Manager on the Navy Engineering Field Activity (EFA) West, Remedial Action Contract (RAC)

Naval Station Treasure Island, San Francisco, California.

Currently serve as the Lead QC Manager. Responsible for the planning, development and project team implementation of Project QC Plans and documentation on 10 environmental cleanup contract task orders with a total budget of over $37M. Projects involve the design, construction, operation, optimization and maintenance of remediation action systems (e.g., Soil Vapor Extraction); soil sampling, analysis, excavation, treatment, transportation and disposal; and site restoration in sensitive public housing areas. Mr. Laws effectively plans, coordinates and verifies task-specific QC inspections with Task Leaders, the Site Health & Safety Officer, Navy Resident Officers in Charge of Construction (ROICCs) and subcontractors. Mr. Laws also performs independent quality assurance audits, surveillances, and inspections of laboratories and field project activities to verify compliance with established QA program requirements.

China Lake Naval Air Weapons Station, Ridgecrest, California.
Served as the Project QC Manager. Responsible for the implementation of the site specific work plans and the quality control plans. Also responsible for daily field inspections to ensure that all work was performed in accordance with the work plan, specifications and requirements based on the program contract. Responsibilities also included performing reviews of documentation and the preparation of daily CQC reports that were submitted to the Navy on the next business morning.

Naval Communication Station, Stockton, California.
Served as the Site Health and Safety Officer. Responsible for providing independent surveillance of the routine implementation of the site safety and health plan. Conducted daily Tailgate Safety Meetings, verified personnel had necessary training and medical clearance to enter work area, performed daily equipment calibrations, monitored personnel for compliance with site safety and health plans, and performed monthly safety inspections.

Yerba Buena Island Housing, Yerba Buena, California.
Served as the Project QC Manager for Lead Base Paint Abatement. Responsible for the implementation of the site specific work plans and the quality control plans. Also responsible for daily field inspections to ensure that all work was performed in accordance with the work plan specifications and requirements based on the program contract. Responsibilities included performing reviews of documentation and the preparation of daily CQC reports, which were submitted to the Navy on the next business morning.

Alameda Naval air Station, Alameda, California.
Served as the Project QC Manager and Site Superintendent. Responsibilities included implementation of the site specific work and quality control plans. Also responsible for daily field inspections to ensure that all work was performed in accordance with the work plan specifications and requirements based on the program contract. Also performed reviews of documentation and prepared daily CQC reports, which were submitted to the Navy on the next business morning. My responsibilities as Site Superintendent included daily production, scheduling activities, ordering equipment and site safety.

Department of Defense Housing, Novato, California.
Served as the Project QC Manager. Responsible for the implementation of the site specific work and quality control plans, as well as daily field inspections to ensure that all work was performed in accordance with the work plan specifications and requirements based on the program contract. Responsibilities included performing reviews of documentation and the preparation of daily CQC reports that were submitted to the Navy on the next business morning.

Naval Medical Center, Oakland, California.
Served as the Project QC Manager. Responsible for the implementation of the site specific work and quality control plans in addition to daily field inspections to ensure that all work was performed in accordance with the work plan specifications and requirements, which were based on the program contract. Responsibilities included performing reviews of documentation and the preparation of daily CQC reports which were submitted to the Navy on the next business

08/1995 - 10/1996
Quality Control Coordinator, IT Corporation, San Jose, California

1995 - 1996 IT Corporation, San Jose, California
Quality Control Coordinator, Engineers Services
Responsible for field QC activities, ensuring that fieldwork was being performed in accordance with the requirements written in the project work plans and procedures. Specific project experience and responsibilities included:

Hamilton Army Air Field, Novato, California.
Served as a Quality Control Inspector for the QC group. Responsible for daily field inspections and the preparation of daily QC reports. Performed reviews of documentation and other duties designated by the Program QC Manager.

07/1993 - 08/1995
Field Analytical Specialist II, IT Corporation, Field Analytical Services, Martines, California

1993 - 1995 IT Corporation, Martinez, California
Field Analytical Specialist II, Field Analytical and Sampling (FAS)
Responsible for organizing and participating in field analytical and sampling activities. Ensured sample protocols were followed, and coordinated between field and laboratory to meet project needs. Specific project experience and responsibilities included the following:

IBM, San Jose, California.
Served as a "lead man" for a demolition crew of three to six employees. Responsible for guidance and inspection of crew?s work. Insured health and safety around work area.

MCAGCC, Twenty Nine Palms, California.
Served as the sample coordinator working with the Jacobs Engineers Group Navy/Clean program at this DOE Superfund site. Acted as Liaison between the field and the laboratory: ordering glassware, coordinating sampling, documenting sampling, and maintaining the field database.

03/1989 - 07/1993
Assistant Field Analytical Specialist, IT Corporation, Martinez, California

1989 - 1993 IT Corporation, Martinez, California
Assistant Field Analytical Specialist, Field Analytical and Sampling (FAS)
Responsible for environmental monitoring on various RI/FS projects in the Western United States. Primary responsibilities were groundwater compliance, soil organic vapor sampling, and soil sampling. Some specific experience include the following:

Mather Air Force Base, Rancho Cordova, California.
Served as a sample team leader in the areas of SOV, soil, and groundwater sample collection. Trained new employees in proper sampling and documentation procedures. Responsible for providing instruction and performing tasks in the areas of monitoring well development, dedicated pump and packer installation, and proper operation of such equipment. Gained experience with sample collection around drill rigs and a clearance for work on military flight lines. Acted as liaison between the field and analytical laboratory. Fulfilled the Sample Coordinator's position in his absence.

Castle Air Force Base, Merced, California.
Served as Assistant Sample Coordina¬tor during this major RI/FS project. Acted as liaison between the field operations and the office. Helped supervise the groundwater sampling and pump installation phases of the project.

U.S. ARMY CORPS OF ENGINEERS

USACE LEARNING CENTER
HUNTSVILLE, ALABAMA

NAVFAC

CERTIFICATE

LEE LAWS

#SPK511400875

has completed the Corps of Engineers and Naval Facility Engineering Command Training Course

CONSTRUCTION QUALITY MANAGEMENT FOR CONTRACTORS - #784

SACRAMENTO, CA	7/17-7/18/14	SACRAMENTO/SPK	DREW A. PERRY
Location	Training Date(s)	Instructional District/ NAVFAC	CQM-C Manager
DREW A. PERRY	DREW.A.PERRY@USACE.ARMY.MIL	(916) 557-7779	
Facilitator/Instructor	Email	Telephone	Facilitator/Instructor Signature
			Chief, USACE Learning Center

THIS CERTIFICATE EXPIRES FIVE YEARS FROM DATE OF ISSUE
CQM-C Recertification online course: https://www.myuln.net

Attachment 4
Alternate Project Quality Control Manager Letter of Designation, Resume, and Construction Quality Management Training Certificate

CONTRACTOR QUALITY CONTROL PLAN—PARCEL F
Radiological Work Tasks, Remedial Action and Maintenance of Remedies
Hunters Point Naval Shipyard
San Francisco, California
Contract Number N62473 17 D 0006
Contract Task Order N62473-17-F-4550

ALTERNATE PROJECT QUALITY CONTROL MANAGER
LETTER OF DESIGNATION

July 3, 2018

Mr. Mark Vennemeyer, Ms. Barbara Matz, Mr. Kevin O'Leary, Mr. Michael Lightner, Ms. Amy Meldrum:

This letter will serve to assign you as Aptim Federal Services, LLC Alternate Project Quality Control (QC) Manager for the above-captioned contract task order. In the case where the designated Project QC Manager, Mr. Lee Laws is unable to perform the Project QC Manager's duties, you will serve in that capacity with his responsibilities and authorities, report directly to me, and administer the established requirements of the contract and Project QC Plan. You will manage the three phases of control. You are authorized to stop work that is not in accordance with the contract and will exercise this authority consistent with Aptim Federal Services, LLC policies and procedures. You are granted the authority to approve submittals that have been certified by qualified submittal reviewers as identified in the organization chart for this task order and as necessary to ensure the quality of the work, and direct the removal and/or replacement of nonconforming materials or work. You are authorized to act as an alternate for two weeks at one time and not more than 30 workdays during a calendar year. In the case where it is believed that these time periods will be exceeded, you must notify me.

If you have any questions or require additional information, please contact me at 619.446.4552.

Sincerely,

Aptim Federal Services, LLC

Stephen P. Massey

Stephen Massey
Program QC Manager

Last Updated: 03 Oct 2014

Mark J. Vennemeyer

Professional Qualifications

Mr. Vennemeyer has performed waste management activities for twenty-two(22) years for a variety of private and government clients. For the past 10 years, he also serves as a Construction Quality Control Manager and Site Health and Safety Officer in addition to Transportation and Disposal Coordinator for Shaw's Government Services division in California. He is responsible for ensuring quality standards of workmanship on various remediation projects, inspection of activities and adherence with contractual requirements, safety of workers, compliance with regular training and medical oversight, waste characterization/classification, regulatory oversight, providing technical assistance in matters of Waste Transportation and Disposal Subcontracts, waste sampling, coordination and management of resources necessary to perform off-site transportation and disposal, preparation of waste profiles and shipping papers, and tracking waste shipments to ensure compliance with all applicable regulations.

Mr. Vennemeyer is experienced in "unknown" identification, Treatment Technology requirements, Federal and State (California) waste regulations, and database management. He has great familiarity with CB&I's Safety policies and capability to identify and implement safe work practices in the field.

Education

Bachelor of Science, Chemistry, University of California, Irvine, Irvine, California, [redacted]

Additional Training/Continuing Education

Shipping Hazardous Materials, San Jose, CA, 2014
SARA-OSHA 8-hour refresher, Online, 2014
First Aid / CPR, Concord, CA, 2012
OSHA 30 Hour Construction Safety, On-line, 2010
Construction Quality Management for Contractors, Concord, CA, 2010
Site Safety Officer, Irvine, CA, 2006
IATA Dangerous Goods Shipment, Emeryville, CA, 2004
Hazardous Waste Manifesting, Alameda, CA, 2002
Cyanide Training, Richmond, CA, 1998
Hazardous Waste Supervisor, Richmond, CA, 1998
Hazard Categorization, San Jose, CA, 1995
Emergency Response Training, San Jose, CA, 1995
Radiation Worker 2, Lawrence Livermore National Lab, 1994
40-Hour Hazardous Waste Operations, Sacramento, CA, 1992

Experience and Background

11/2011 - Present
QC Manager / Site Safety and Health Officer, CB&I Federal Services, San Francisco, California

QC manager and Safety officer for several large remedial projects at former Hunters Point Naval shipyard in San Francisco.
Operations included Radiological investigation and remediation; Soil Excavation and backfill; SVE System installation; Zero-valent iron and Bio-substrate Injection; Sampling and Analysis; Munitions investigation.
No lost-time incidents occurred during the project execution.

06/2007 - 10/2011
Quality Control Manager / Site Health and Safety Officer, Shaw Environmental & Infrastructure, Inc., Government Services, Alameda, California

Quality Control manager and Site Safety officer at the Alameda Point project(s). Pojects included contruction of in-situ Remediation systems (DVE for petroleum contamination, 6-phase underground heating for DNAPL plume).

The following is a summary of key projects:
<u>Health & Safety / Quality control, Tank Closure Work / InSitu Treatability Study; Concord NWS, 140389, US Navy, Concord Naval Weapon Station, Concord, CA, 03/2011 - Present</u>
2 Projects: #1 is a Treatability Study using injection to perform bioaugmentation and In-Situ treatment of chlorinated compounds. Site characterization and installation of monitoring wells was also preformed. A Solar-powered SVE system will be used to further remediate the site.
#2 was a project to remove five (5) underground fuel tanks from the former Base gas station. All tanks had been cleaned by a previous contractor, Shaw was responsible for the removal of tanks and associated piping as well as backfill / restoration of site.

Accomplishments:
Work performed with no lost-time incidents and successful coordination between base personnel, subcontractors and Shaw staff.

<u>QC & H&S, Moffett Field, 133816, US Navy, Moffett Field, Mountain View, CA, 05/2009 - Present</u>
Site characterization and chemical / biological injection for treatment of chlorinated solvent contamination at 2 sites on Moffett Field. Installation of Monitoring wells, chemical injection and periodic groundwater monitoring are tasks under this job.

Accomplishments:
none

04/2006 - 06/2007
Quality Control Manager, Shaw Environmental & Infrastructure, Inc., Government Services, San Francicso, California

Served as Quality Control Manager and T&D Coordinator at former Treasure Island naval base. Acted as liaison between Navy construction personnel (engineers, Construction technicians) and Shaw. Provided daily reporting and documentation of activities performed each day.

12/2005 - 04/2006
Quality Control Manager / Inspector, Shaw Environmental & Infrastructure, Inc., Government Services, San Diego, California

Worked with operations personnel to establish QC procedures and documentation of Navy owned Treatment, Storage and Disposal facility. Inspection of satellite facility(ies) for compliance to Navy and regulatory requirements.

02/2005 - 11/2005
Construction Quality Control Manager, Shaw Environmental & Infrastructure, Inc., Government Services, Concord, California

Responsibilities include support of client projects as quality control manager. Also responsible for interaction with client's technical representatives, preparing portions of reports, oversight of field work, inspection of materials and work performed.

The following is a summary of key projects:
CQC Manager / SSHO, In-situ Treatability Study, 133816, US Navy, Moffett Federal Airfield, CA, 05/2009 - present
Treatability study for the in-situ remediation of chlorinated solvents. Injection of three (3) separate treatment compounds in distinct areas was done with a quarterly groundwater monitoring program to measure results.

Accomplishments:
All work accomplished with zero lost time incidents

Other Comments:
Additional work was awarded as followup to the initial activities.

QA Inspector, New York City Rapid Repairs Program, 148103, New York City Housing Authority, New York City, New York, $40,000,000.00, 01/2013 - 02/2013
Performed Construction Quality Oversight on work completed by city contractors. Work reviewed included temporary repair of homes damaged by Superstorm Sandy, replacement of water damaged electrical systems, home heating (boiler/furnace) and hot water. Verify and quantify work completed as part of project closeout.

Quality Control Manager / Alternate Site Safety & Health Officer, Hunters Point Shipyard, various, US Navy - BRAC-PMO-W, Hunters Point, San Francisco, CA, $23,000,000.00, 11/2011 - 11/2012
Multiple projects were simultaneously performed at Hunters Point Shipyard. These projects included the Remediation of soils contaminated with Polychlorinated Biphenyls (PCBs), removal of sanitary sewers and storm drain utilities contaminated with radiological hazards, investigation of chlorinated compounds in groundwater, and removal action for a potentially radiologically impacted site.

Accomplishments:
Zero Lost Time during project.

Awards/Client Commendations:
1000 day President's Safety Award.

05/2002 - 02/2005
Transportation and Disposal Coordinator, Shaw Environmental & Infrastructure, Inc., Government Technical Services, Concord, California

Responsibilities include providing technical support for clients as a transportation and disposal coordinator. Also responsible for waste characterization, profiling, manifesting, coordination of subcontractors and disposal facilties for remedial actions, waste tracking and technical documentation of removal / disposal actions.

The following is a summary of key projects:
T&D Coordinator, Carmel Valley Manor, , JM Electric, Carmel, CA, $20,000.00, 03/2005 - 03/2005
Removal and disposal of aged transformers and electrical equipment. Tasks included sampling, characterizing, profiling, manifesting, packaging of equipment according to all applicable federal, state and local regulations.

Transportation and Disposal Coordinator, Hunters Point Shipyard, various, U.S. Navy, San Francisco, CA, 02/2002 - 02/2005
Transport and Disposal Coordinator for various projects at Hunters Point. Responsible for waste sampling, characterization, profiling, manifesting, coordination of waste shipments and technical documentation of disposal activities.
During the span of the project, over 20,000 tons of waste was removed from site and sent to various permitted treatment/disposal facilties.

Transportation and Disposal Coordinator, Alameda Point, former Alameda Naval Air Station, various, U.S. Navy, Alameda, CA, 02/2002 - 02/2005
Coordination of disposal activities for various remedial projects at the Former Alameda Naval Air Station. Tasks included Investigation Derived and Treatment by-product Waste sampling, characterization, profiling, manifesting and coordination of disposal.

Awards/Client Commendations:
President's Safety Award

Transport and Disposal Coordinator, ORC - Cyril, 100735, US EPA, Cyril, OK, $6,000,000.00, 09/2003 - 06/2004
Demolition of a shut-down oil refinery. Disposal of all wastes associated with the facility including petroleum by-products, chemical catalysts, construction demolition debris, abandoned drummed wastes and "laboratory size" chemical bottles.
Much of the structure was recycled as scrap metal, but the area was cleared of Asbestos prior to any demolition activites starting.

Transport and Disposal Coordinator, Hamilton Army Airfield, US Army Corp of Engineers, Novato, CA, 05/2002 - 12/2002
This project was the removal from site and disposal of several thousand tons of waste excavated soil that was staged on site at an Army Airfield that was in closure. Tasks included classification of waste based on analytical results of samples, profiling of waste to seleceted TSDFs, tracking of waste shipments (using the manifest shipping documents) and confirmation of costs associated with transportation and disposal of waste.

12/2000 - 02/2002
Transportation and Disposal Coordinator, IT Corporation (The Shaw Group Inc. acquired substantially all of the operating assets of The IT Group, Inc., on May 23, 2002), Government Services, Concord, California

Responsibilities included providing technical support to client projects as Transport and Disposal coordinator. Also responsible for field support of waste disposal operations, support of business development activities and composition of certain technical sections of reporting documents.

Mark J. Vennemeyer

Title: Scientist 3
Employee Number: [redacted]
Location: Concord, CA
Location2:
Business Unit: QA/QC, Field
Company: CBI Federal Services

Contact Information

Work Phone: 925-288-2383
Cell Phone: 925.383.6502

Skills

Group: ACCESS AUTHORIZATION
Category: SECURITY
Skill/Experience Level: Internet: Fundamental Knowledge
Skill/Experience Level: Microsoft Acrobat: Fundamental Knowledge
Skill/Experience Level: Microsoft Excel: Fundamental Knowledge
Skill/Experience Level: Microsoft Word: Fundamental Knowledge

Group: BUSINESS ADMINISTRATION SPECIALTIES
Category: EXECUTIVE MANAGEMENT
Skill/Experience Level: Corporate Policies & Procedures Administration: Fundamental Knowledge
Skill/Experience Level: Project Management: Fundamental Knowledge
Category: LEGAL
Skill/Experience Level: Environmental Law : Working Knowledge
Category: PROPOSALS
Skill/Experience Level: Letter Proposals : Fundamental Knowledge
Skill/Experience Level: Project Descriptions : Fundamental Knowledge
Skill/Experience Level: Resumes : Fundamental Knowledge
Skill/Experience Level: Scope of Work Analysis : Fundamental Knowledge
Skill/Experience Level: Technical Writing : Fundamental Knowledge

Group: COMPUTER/INFORMATION TECHNOLOGY SPECIALTIES
Category: COMPUTER APPLICATIONS (User)
Skill/Experience Level: Adobe Acrobat : Working Knowledge
Skill/Experience Level: DOS : Fundamental Knowledge
Skill/Experience Level: Internet : Working Knowledge
Skill/Experience Level: Lotus 1-2-3 : Fundamental Knowledge
Skill/Experience Level: ManageIT : Working Knowledge
Skill/Experience Level: Microsoft Access : Fundamental Knowledge
Skill/Experience Level: Microsoft Excel : Senior
Skill/Experience Level: Microsoft Power Point : Working Knowledge
Skill/Experience Level: Microsoft Word : Senior
Skill/Experience Level: Win 95 : Fundamental Knowledge
Skill/Experience Level: Windows 3.x : Fundamental Knowledge
Skill/Experience Level: Windows 98 : Fundamental Knowledge

Skill/Experience Level: Windows Vista: Working Knowledge
Skill/Experience Level: Windows XP : Working Knowledge
Skill/Experience Level: WordPerfect for Windows : Fundamental Knowledge
Category: COMPUTER/GENERAL
Skill/Experience Level: Computers (desktops/laptops) : Working Knowledge
Skill/Experience Level: Local Area Networks : Fundamental Knowledge
Skill/Experience Level: Peripherals : Fundamental Knowledge

Group: CONSTRUCTION/REMEDIATION SPECIALTIES
Category: CONSTRUCTION/REMEDIATION
Skill/Experience Level: Backfilling : Working Knowledge
Skill/Experience Level: Compaction : Working Knowledge
Skill/Experience Level: Concrete : Fundamental Knowledge
Skill/Experience Level: Construction Management : Fundamental Knowledge
Skill/Experience Level: Demolition : Fundamental Knowledge
Skill/Experience Level: Excavation : Working Knowledge
Skill/Experience Level: Field Inspection : Working Knowledge
Skill/Experience Level: General Construction : Fundamental Knowledge
Skill/Experience Level: Lead-Based Paint Abatement : Fundamental Knowledge
Skill/Experience Level: MTBE : Fundamental Knowledge
Skill/Experience Level: Operation/Maintenance : Fundamental Knowledge
Skill/Experience Level: Oversight : Fundamental Knowledge
Skill/Experience Level: Piping : Fundamental Knowledge
Skill/Experience Level: Site Remediation : Working Knowledge
Skill/Experience Level: Soil Handling/Testing : Fundamental Knowledge
Skill/Experience Level: Stabilization : Fundamental Knowledge
Skill/Experience Level: System Dismantling : Fundamental Knowledge
Skill/Experience Level: Transportation and Disposal : Expert
Skill/Experience Level: Trenching : Fundamental Knowledge
Category: GENERAL/SKILLED LABOR
Skill/Experience Level: Carpentry : Fundamental Knowledge
Skill/Experience Level: Concrete Finishing : Fundamental Knowledge
Skill/Experience Level: Pipe Fitting : Fundamental Knowledge
Skill/Experience Level: Trenching : Fundamental Knowledge
Skill/Experience Level: Welding : Fundamental Knowledge

Group: CONSULTING SPECIALTIES
Category: ASSESSMENT/EVALUATION
Skill/Experience Level: Radiological Surveys : Fundamental Knowledge
Skill/Experience Level: RCRA Facility Assessment : Fundamental Knowledge
Skill/Experience Level: Waste Characterization : Expert
Category: AUDITS
Skill/Experience Level: Compliance : Fundamental Knowledge
Skill/Experience Level: Environmental : Fundamental Knowledge
Skill/Experience Level: Health & Safety : Senior
Skill/Experience Level: Protocol Development : Fundamental Knowledge
Skill/Experience Level: Quality Assurance : Fundamental Knowledge
Category: CONSULTING
Skill/Experience Level: EH&S Management : Fundamental Knowledge
Category: HOMELAND SECURITY
Skill/Experience Level: Contaminated Waste Disposal : Senior

Skill/Experience Level: Debris and Waste Management : Working Knowledge
Skill/Experience Level: Hazardous Substance Characterization : Senior
Category: LAND PLANNING
Skill/Experience Level: Regulatory Compliance : Working Knowledge
Category: OUTSOURCING/PRIVATIZATION
Skill/Experience Level: Construction Management : Fundamental Knowledge
Category: TRAINING (Provided to Client)
Skill/Experience Level: Asbestos Abatement : Fundamental Knowledge
Skill/Experience Level: Emergency Response to Hazardous Substance Releases : Working Knowledge
Skill/Experience Level: Environmental Regulations Course : Working Knowledge
Skill/Experience Level: Government Compliance : Fundamental Knowledge
Skill/Experience Level: Hazard Communication : Working Knowledge
Skill/Experience Level: Hazardous Waste Operations : Senior
Skill/Experience Level: Health and Safety Courses and Seminars : Fundamental Knowledge
Skill/Experience Level: Operations : Fundamental Knowledge
Skill/Experience Level: Project Management : Fundamental Knowledge
Skill/Experience Level: Quality Assurance/Quality Control : Fundamental Knowledge
Skill/Experience Level: RCRA Site-Specific Course : Fundamental Knowledge
Skill/Experience Level: Regulatory : Working Knowledge
Skill/Experience Level: Specific Chemical Hazards : Fundamental Knowledge
Skill/Experience Level: Total Quality Management : Fundamental Knowledge

Group: ENERGY DELIVERY SERVICES
Category: EQUIPMENT OPERATED
Skill/Experience Level: Air Compressor: Fundamental Knowledge
Skill/Experience Level: Articulated Truck: Fundamental Knowledge
Skill/Experience Level: Backhoe: Fundamental Knowledge
Skill/Experience Level: Backhoe/Excavator: Fundamental Knowledge
Skill/Experience Level: Bobcat: Fundamental Knowledge
Skill/Experience Level: CAT 320 Excavator: Fundamental Knowledge
Skill/Experience Level: Dozer/Loader: Fundamental Knowledge
Skill/Experience Level: Drill Rig: Fundamental Knowledge
Skill/Experience Level: Fork Lift: Working Knowledge
Skill/Experience Level: Front End Loader: Fundamental Knowledge
Skill/Experience Level: Jack Hammer: Fundamental Knowledge
Skill/Experience Level: Man Lifts: Fundamental Knowledge
Skill/Experience Level: Skid Steer: Fundamental Knowledge
Skill/Experience Level: Truck (Fundamental Knowledge
Skill/Experience Level: Vac Truck: Fundamental Knowledge

Group: ENVIRONMENTAL SPECIALTIES
Category: AIR
Skill/Experience Level: Perimeter Monitoring : Fundamental Knowledge
Category: ANALYTICAL
Skill/Experience Level: Data Validation : Fundamental Knowledge
Skill/Experience Level: Field Analytical Methods : Working Knowledge
Skill/Experience Level: Geotechnical Testing : Fundamental Knowledge
Skill/Experience Level: Laboratory Analytical Methods : Working Knowledge
Skill/Experience Level: X-ray Fluorescence (XRF): Fundamental Knowledge
Category: REGULATORY

Skill/Experience Level: Analysis : Fundamental Knowledge
Skill/Experience Level: CERCLA : Working Knowledge
Skill/Experience Level: Code of Federal Regulations : Senior
Skill/Experience Level: Compliance : Fundamental Knowledge
Skill/Experience Level: Emergency Response: Fundamental Knowledge
Skill/Experience Level: Hazardous Waste Evaluation : Senior
Skill/Experience Level: RCRA Compliance : Working Knowledge
Skill/Experience Level: TSCA : Working Knowledge
Category: WASTE MINIMIZATION/POLLUTION PREVENTION
Skill/Experience Level: Recycling : Fundamental Knowledge
Skill/Experience Level: Waste Minimization/Pollution Control : Fundamental Knowledge

Group: FACILITY MANAGEMENT-SRM/MISSION SUPPORT SERVICES
Category: BUSINESS OPERATIONS
Skill/Experience Level: Administration : Fundamental Knowledge
Skill/Experience Level: Procurement : Fundamental Knowledge
Skill/Experience Level: Property Management : Fundamental Knowledge
Skill/Experience Level: Quality Control : Senior
Skill/Experience Level: Safety Management : Senior
Category: ENVIRONMENTAL SERVICES
Skill/Experience Level: Bilge & Oily Waste Treatment Plant O&M : Fundamental Knowledge
Skill/Experience Level: Hazardous Waste Handling, Storage & Disposal : Expert
Skill/Experience Level: Laboratory Services : Fundamental Knowledge
Category: JOC/IDIQ/SUSTAINABILITY, RELIABILITY, MAINTENANCE (SRM) CONSTRUCTION
Skill/Experience Level: Construction Management : Fundamental Knowledge
Skill/Experience Level: Project Management : Fundamental Knowledge
Skill/Experience Level: Quality Control : Working Knowledge
Skill/Experience Level: Superintendent : Fundamental Knowledge
Category: LOGISTICS
Skill/Experience Level: Shipping & Packing : Fundamental Knowledge
Skill/Experience Level: Warehouse Operations : Fundamental Knowledge
Category: ROADS & GROUNDS SERVICES
Skill/Experience Level: Erosion Control : Fundamental Knowledge
Category: VEHICLE/EQUIPMENT O&M
Skill/Experience Level: Equipment Operations : Fundamental Knowledge
Skill/Experience Level: Vehicle Operations : Fundamental Knowledge

Group: FIELD SERVICES SPECIALTIES
Category: ABOVEGROUND STORAGE TANKS
Skill/Experience Level: Aboveground Storage Tanks : Fundamental Knowledge
Skill/Experience Level: Cleaning : Fundamental Knowledge
Skill/Experience Level: Removal : Fundamental Knowledge
Category: ASBESTOS
Skill/Experience Level: Abatement : Fundamental Knowledge
Skill/Experience Level: Asbestos : Fundamental Knowledge
Category: DRILLING
Skill/Experience Level: Borings : Working Knowledge
Skill/Experience Level: Drilling : Working Knowledge
Skill/Experience Level: Geoprobe : Working Knowledge
Skill/Experience Level: Monitoring Well Installation : Working Knowledge

Skill/Experience Level: Recovery Well Installation : Fundamental Knowledge
Category: DRUMS
Skill/Experience Level: Cleaning : Fundamental Knowledge
Skill/Experience Level: Crushing/Disposal : Senior
Skill/Experience Level: Drums : Expert
Skill/Experience Level: Removal : Fundamental Knowledge
Skill/Experience Level: Selection of Drum Type: Senior
Skill/Experience Level: Testing : Fundamental Knowledge
Skill/Experience Level: Waste Characterization : Expert
Skill/Experience Level: Waste Disposal & Shipping : Expert
Category: EQUIPMENT SKILLS
Skill/Experience Level: Backhoe: Fundamental Knowledge
Skill/Experience Level: Bobcat: Fundamental Knowledge
Skill/Experience Level: Bulldozer: Fundamental Knowledge
Skill/Experience Level: CAT 320 Excavator: Fundamental Knowledge
Skill/Experience Level: Drill Rig: Fundamental Knowledge
Skill/Experience Level: Dump Truck: Fundamental Knowledge
Skill/Experience Level: Fork Lift: Working Knowledge
Skill/Experience Level: Front End Loader: Fundamental Knowledge
Skill/Experience Level: Man Lifts: Fundamental Knowledge
Skill/Experience Level: Truck (Fundamental Knowledge
Skill/Experience Level: Truck (>26,001): Fundamental Knowledge
Skill/Experience Level: Vac Truck: Working Knowledge
Skill/Experience Level: Water Truck: Fundamental Knowledge
Category: OPERATIONS AND MAINTENANCE
Skill/Experience Level: Manuals/Procedures : Fundamental Knowledge
Skill/Experience Level: Pilot-Plant Operations : Fundamental Knowledge
Skill/Experience Level: Soil Vapor Extraction Systems : Fundamental Knowledge
Skill/Experience Level: Wastewater Treatment Plant Operations : Fundamental Knowledge
Category: SAMPLING
Skill/Experience Level: Air : Fundamental Knowledge
Skill/Experience Level: Drilling : Fundamental Knowledge
Skill/Experience Level: Drums : Working Knowledge
Skill/Experience Level: Fixed Laboratory Analysis : Fundamental Knowledge
Skill/Experience Level: Mobile Laboratory Analysis : Fundamental Knowledge
Skill/Experience Level: Sampling : Working Knowledge
Skill/Experience Level: Soil : Working Knowledge
Skill/Experience Level: Underground Storage Tanks : Fundamental Knowledge
Skill/Experience Level: Wipe : Working Knowledge
Category: SURVEY
Skill/Experience Level: General Surveying : Fundamental Knowledge
Skill/Experience Level: GPS Control : Fundamental Knowledge
Skill/Experience Level: Hazardous Waste Survey : Fundamental Knowledge
Skill/Experience Level: Horizontal and Vertical Control : Fundamental Knowledge
Skill/Experience Level: Topographic : Fundamental Knowledge
Skill/Experience Level: Utility Locates : Fundamental Knowledge
Category: UNDERGROUND STORAGE TANKS
Skill/Experience Level: Cleaning : Fundamental Knowledge
Skill/Experience Level: Removal : Fundamental Knowledge
Skill/Experience Level: Testing : Fundamental Knowledge
Skill/Experience Level: Underground Storage Tanks : Fundamental Knowledge

Group: PROJECT MANAGEMENT SPECIALTIES
Category: CONSTRUCTION MANAGEMENT - SUBCONTRACTS ADMINISTRATION
Skill/Experience Level: Bid Analysis: Working Knowledge
Skill/Experience Level: Change Management: Fundamental Knowledge
Skill/Experience Level: File Management: Fundamental Knowledge
Skill/Experience Level: Spreadsheet Development: Fundamental Knowledge
Skill/Experience Level: Subcontract Bid Evaluation: Fundamental Knowledge
Skill/Experience Level: Subcontract Conformance: Fundamental Knowledge
Skill/Experience Level: Subcontract Pricing and Costing: Fundamental Knowledge
Skill/Experience Level: Subcontractor Prequalification Review: Fundamental Knowledge
Skill/Experience Level: Time and Materials Cost Control: Fundamental Knowledge
Skill/Experience Level: Union Labor Experience: Fundamental Knowledge
Category: ENGINEERING PROJECT CONTROLS
Skill/Experience Level: Construction Management Planning & Scheduling : Fundamental Knowledge
Category: PROCUREMENT
Skill/Experience Level: Inspection: Fundamental Knowledge
Skill/Experience Level: Logistics: Fundamental Knowledge
Skill/Experience Level: Purchasing: Fundamental Knowledge
Category: PROJECT ACCOUNTING
Skill/Experience Level: Billing Support : Fundamental Knowledge
Skill/Experience Level: Cost Accounting : Fundamental Knowledge
Skill/Experience Level: Government Property : Fundamental Knowledge
Skill/Experience Level: Procurement/Sourcing : Fundamental Knowledge
Skill/Experience Level: Shaw Policies/Procedures : Working Knowledge
Category: PROJECT MANAGEMENT
Skill/Experience Level: Construction Management : Fundamental Knowledge
Skill/Experience Level: Contract Management - Cost Reimbursable: Fundamental Knowledge
Skill/Experience Level: Contract Management - Firm Fixed Price: Fundamental Knowledge
Skill/Experience Level: Contract Management - T&M : Fundamental Knowledge
Skill/Experience Level: Cost/Scheduling : Fundamental Knowledge
Skill/Experience Level: Project Management : Fundamental Knowledge
Skill/Experience Level: Site Management : Fundamental Knowledge
Skill/Experience Level: Technical/Report Writing : Fundamental Knowledge

Group: TECHNICAL SPECIALTIES
Category: CONTAMINANT REMEDIATION
Skill/Experience Level: Acids : Fundamental Knowledge
Skill/Experience Level: Alkaline : Fundamental Knowledge
Skill/Experience Level: Arsenic : Fundamental Knowledge
Skill/Experience Level: Benzene : Fundamental Knowledge
Skill/Experience Level: Cadmium : Fundamental Knowledge
Skill/Experience Level: Chromium : Fundamental Knowledge
Skill/Experience Level: Compressed Gases: Fundamental Knowledge
Skill/Experience Level: Corrosives : Fundamental Knowledge
Skill/Experience Level: Cyanide : Fundamental Knowledge
Skill/Experience Level: DCA : Fundamental Knowledge
Skill/Experience Level: DCE : Fundamental Knowledge
Skill/Experience Level: Dioxin : Fundamental Knowledge
Skill/Experience Level: Flammable : Working Knowledge

Skill/Experience Level: Heavy Metals : Working Knowledge
Skill/Experience Level: Lead : Working Knowledge
Skill/Experience Level: Lead-Based Paint : Working Knowledge
Skill/Experience Level: Mercury : Fundamental Knowledge
Skill/Experience Level: Oil Refinery Waste : Fundamental Knowledge
Skill/Experience Level: Oily Sludge : Fundamental Knowledge
Skill/Experience Level: PCA : Fundamental Knowledge
Skill/Experience Level: PCE : Fundamental Knowledge
Skill/Experience Level: Petrochemical Refinery Waste : Fundamental Knowledge
Skill/Experience Level: Petroleum/Oil : Working Knowledge
Skill/Experience Level: Radioactive Waste (i.e., Plutonium, Uranium, etc.) : Fundamental Knowledge
Skill/Experience Level: Reactives (Air, Water) : Fundamental Knowledge
Skill/Experience Level: TCA : Fundamental Knowledge
Skill/Experience Level: TCE : Fundamental Knowledge
Skill/Experience Level: TPH : Working Knowledge
Skill/Experience Level: TSCA Managed Waste : Working Knowledge
Category: HEALTH AND SAFETY
Skill/Experience Level: Accident Investigation : Working Knowledge
Skill/Experience Level: Construction : Working Knowledge
Skill/Experience Level: Health Physics : Fundamental Knowledge
Skill/Experience Level: Industrial Hygiene : Fundamental Knowledge
Skill/Experience Level: Manuals/Procedures : Fundamental Knowledge
Skill/Experience Level: Noise : Working Knowledge
Skill/Experience Level: OSHA Reportables : Working Knowledge
Skill/Experience Level: Personnel Monitoring : Working Knowledge
Skill/Experience Level: Program Development : Fundamental Knowledge
Skill/Experience Level: Site Safety/Health Officer : Expert
Category: MIXED WASTE
Skill/Experience Level: Characterization : Fundamental Knowledge
Skill/Experience Level: Mixed Waste : Fundamental Knowledge
Category: NUCLEAR/RADIOLOGY
Skill/Experience Level: Radioactive Waste Management : Fundamental Knowledge
Category: QUALITY ASSURANCE
Skill/Experience Level: Analytical/Chemical Quality : Fundamental Knowledge
Skill/Experience Level: Construction : Working Knowledge
Skill/Experience Level: Engineering : Working Knowledge
Skill/Experience Level: Manuals/Procedures : Fundamental Knowledge
Skill/Experience Level: Plan Preparation : Fundamental Knowledge
Skill/Experience Level: Quality Control : Senior
Category: TREATMENT/REMEDIATION
Skill/Experience Level: Air Sparging : Fundamental Knowledge
Skill/Experience Level: Bioremediation : Fundamental Knowledge
Skill/Experience Level: Chemical Oxidation : Fundamental Knowledge
Skill/Experience Level: Contaminated Sediments : Fundamental Knowledge
Skill/Experience Level: Decontamination : Working Knowledge
Skill/Experience Level: Demolition : Fundamental Knowledge
Skill/Experience Level: Excavation : Working Knowledge
Skill/Experience Level: Groundwater Treatment : Fundamental Knowledge
Skill/Experience Level: Hazardous Materials Cleanup : Working Knowledge
Skill/Experience Level: Hazardous Waste Transportation : Senior

Skill/Experience Level: Soil Remediation : Fundamental Knowledge
Skill/Experience Level: Treatability Testing : Fundamental Knowledge
Skill/Experience Level: Wastewater Treatment : Fundamental Knowledge

Other Information

Years of Experience

Previous Employers: 9.00
CB&I: 14
Total of 23.00 year(s) experience

Experience in EPA Regions

Region 9 (AZ CA HI NV American Samoa, Guam, TT)

Industry Experience

Environmental

(b) (6) [redacted]

(b) (6) [redacted]

U.S. ARMY CORPS OF ENGINEERS

USACE LEARNING CENTER
HUNTSVILLE, ALABAMA

NAVFAC

CERTIFICATE

Mark Vennemeyer

SW9-02-15-00049

has completed the Corps of Engineers and Naval Facility Engineering Command Training Course

CONSTRUCTION QUALITY MANAGEMENT FOR CONTRACTORS - #784

Concord, California	1/29/15 - 1/30/15	SW9 - NAVFAC Southwest	Michael Haliburton PMP , PE
Location	Training Date(s)	Instructional District/ NAVFAC	CQM-C Manager
Kugan Panchadsaram PE	kugan@kugan.com	858-212-2941	
Facilitator/Instructor	Email	Telephone	Facilitator/Instructor Signature

Jeffrey D. Dziedzic
Chief, USACE Learning Center
Jeffrey D. Dziedzic

THIS CERTIFICATE EXPIRES FIVE YEARS FROM DATE OF ISSUE
CQM-C Recertification online course: https://www.myuln.net

Last Updated: 09 Apr 2015

Barbara A. Matz

Professional Qualifications

Ms. Matz has over 25 years of experience in geology and hazardous waste site characterization, including field geology, soil and groundwater sampling, data evaluation, plan preparation, report writing, subcontractor oversight, environmental compliance, interaction with public utilities and regulatory agencies, site safety and QC oversight, and technical review. Ms. Matz has supported, designed, and managed soil and groundwater monitoring programs in accordance with RCRA and CERCLA regulations, and achieved closure of UST sites with approval of State agencies. She has worked with a wide variety of federal and state agencies, as well as large commercial clients. Ms. Matz has maintained excellent client relations, high health and safety standards, and met quality assurance objectives throughout her career. She is a certified Site Safety Officer and Quality Control Manager, and a registered California Professional Geologist.

Education

Master of Science, Geology, University of Nevada - Reno, Reno, Nevada, [redacted]
Bachelor of Science, Geology, University of Nevada - Reno, Reno, Nevada, [redacted]
Bachelor of Science, Biology, Michigan Technological University, Houghton, Michigan, [redacted]

Additional Training/Continuing Education

OSHA 8-hour HAZWOPER refresher, October 2014
USACE Quality Systems Management, online refresher, 2012
Site-specific Radiation Worker Training, Shaw Treasure Island, 2012
10-Hour Construction Safety, Shaw Findlay OH, 2011
50-hour Site Safety Officer Training, Shaw, Findlay OH, 2011
Sustainable Remediation Methods for Soils and Water, UC Berkeley Extension, 2011
XRF Operations and Safety, Shaw San Francisco, 2010
USACE Quality Systems Management, 2007
Contaminant Forensics, NW Env Training Center, 2007
OSHA 1926 Construction Site Supervisor, Shaw E&I, 2004
Characterization & Toxicity Assessment of Mine Waste, Geological Society of America, 2004
Aerial Photography Interpretation Workshop, Groundwater Res Assn of CA, 2003
Ecological Risk Assessment Short Course, UC Berkeley Extension, 2002
Natural Attenuation Short Course, UC Berkeley Extension, 2001
Lead and Asbestos Site Supervisor Refreshers, UC Berkeley Extension, 1997
Asbestos Sampler and Site Supervisor, Field Sciences Inst, Albq NM, 1996
Lead Sampler and Site Supervisor, Field Sciences Inst, Albq NM, 1996
OSHA Excavation Safety Training, IT Corporation, 1994
Graduate Geology Seminars - University of New Mexico, 1991-1993
OSHA Hazardous Waste Site Supervisor, IT Corporation, 1992
Radiation Safety, Sandia National Laboratories, 1991
OSHA 40-Hour Hazardous Waste Operations, IT Corporation, 1989

Registrations/Certifications/Licenses

USACE Construction Quality Control Manager, 2007, Active, Nationwide, expires 10/2017
Professional Geologist, 2000, Active, California #7117, expires 10/2016

Experience and Background

01/2013 – Present
Project Geologist/QCM/SSO, CB&I Federal Services, Concord, California

Acting QCM at former Alameda Naval Station, CA (August 2013 to present); alternate SSO for Site 29, Naval Weapons Station Seal Beach, Concord, CA (August 2013 to present); served as QCM and SSO at former Naval Station Treasure Island, San Francisco, CA (January 2013); provided QC review of reports and plans for a variety of sites in California, Nevada, and Arizona (January 2013 through present); supported U.S. Army Redstone Arsenal, Huntsville, AL, by writing and reviewing various chapters of RI Reports for groundwater and soil sites (February 2013 through present).

01/2007 - 01/2013
Task Manager, Shaw Environmental & Infrastructure, Inc., San Francisco, California

Project: Naval Station Treasure Island. Tasks: Site 12 SWDAs, Building 233 Demolition. Work included task management: subcontractor oversight, plan and report preparation, procurement support, field supervision, client/agency meetings; and QC oversight: inspections, daily reports, meetings, and field work variance preparation; acting QC / SSO during January 2013.

05/2002 - 12/2011
Project Geologist, Shaw Environmental & Infrastructure, Inc., Concord, California

Project: TERC II National Park Service. Provided support to client projects as technical and task manager, site geologist, site safety and QC officer. Investigated sites at national parks including Yosemite, Lassen Volcanic, Redwood, Whiskeytown, and Death Valley. Responsibilities included budget and plan preparation, field work variance preparation, client meetings, supervision of technical staff and subcontractors, data evaluation, and report preparation.

The following is a summary of key projects:
<u>Technical Manager, Treasure Island Site 12, 122412, US Navy, Treasure Island, San Francisco, CA, $12,000,000.00, 03/2007 - present</u>
Remediation of former solid waste disposal areas by excavation and soil replacement, including radiation monitoring and confirmation sampling for chemical and radiological contaminants.

Accomplishments:
Planning, subcontractor oversight, client meetings, data management and presentation, reporting, QC oversight.

<u>Technical/Task Manager, TERC II - NPS, 870508, USACE and National Park Service, Yosemite National Park, CA, $3,000,000.00, 05/1999 - Present</u>
Budget preparation, plan preparation, procurement support, supervision of Shaw and subcontractor field personnel, soil and groundwater sample collection, site safety and QC oversight, data evaluation, report preparation, and meetings with client and regulatory agencies.

Accomplishments:
Closure of three UST sites, closure pending on one additional UST site.

<u>Outreach, WalMart, WalMart, various, 01/2006 - 10/2006</u>
Prepare and distribute Environmental Compliance Manuals to WalMart stores in Arkansas, Louisiana, Arizona, and Colorado.

Accomplishments:
Planning, manual preparation, manual distribution, store manager training.

<u>Site Geologist, Navy CLEAN RAC - NAVSTA Treasure Island, 843431, Navy, Treasure Island, San Francisco, CA, 04/2003 - 06/2005</u>
Building 233 Survey - Procurement support, plan preparation, supervision of Shaw and subcontractor field personnel, soil and groundwater sampling, data evaluation, and report preparation.

<u>Project Geologist, Treasure Island CTO 99, US Navy, Treasure Island, San Francisco, CA, 04/2003 - 02/2005</u>
Data gaps investigation of CERCLA sites.

Accomplishments:
Field sampling, data evaluation, report preparation.

<u>Project Geologist, Hamilton Field, USACE and Army, Hamilton Field, Novato, CA, 06/1997 - 05/1999</u>
Investigation of former army airfield, including soil, sediment, and water sampling.

Accomplishments:
Plan preparation, field sampling, subcontractor oversight, reporting, client and regulatory meetings.

<u>Project Scientist, Sandia National Laboratories, US Department of Energy, Sandia National Laboratories, Albuquerque, NM, 11/1989 - 06/1997</u>
Planning, budget preparation, procurement, field sampling, subcontractor oversight, reporting, client and regulator interaction.

Accomplishments:
Managed groundwater monitoring tasks at two landfills, managed basewide background groundwater monitoring, participated in building decontamination/demolition sampling, and various small sampling and reporting tasks on the base.

<u>Project Scientist, Nevada Test Site, Off-Site Projects, various, US Department of Energy, various sites around U.S., 10/1993 - 05/1997</u>
Supported off-site projects at Hattiesburg MS and Rifle CO - field sampling, subcontractor oversight, reporting. Intermittent assignments concurrent with Sandia and other off-site projects.

Accomplishments:
Managed confirmation sampling program, installed deep monitoring wells, met site requirements within QC and H&S standards.

<u>Project Scientist, Carswell NAS, US Navy, Carswell Naval Air Station, Forth Worth TX, 04/1995 - 05/1995</u>
Monitoring well installation, groundwater sampling.

Accomplishments:
Subcontractor oversight, client interaction.

04/2003 - 01/2007
Task Manager, Shaw Environmental & Infrastructure, Inc., San Francisco, California

Project: Naval Station Treasure Island. Tasks: Environmental Baseline Study, Site 12 Trench Investigation, Building 233 Survey. Work included field sampling, subcontractor oversight, plan and report preparation, procurement support, client meetings.

06/1997 - 05/2002
Project Geologist, IT Corporation (The Shaw Group Inc., acquired substantially all of the operating assets of The IT Group, Inc., on May 23, 2005), Concord, California

Performed as task manager, technical manager, and site geologist for a variety of sites and clients. Responsible for budget input, plan preparation, procurement support, field planning, field supervision of staff and subcontractors, review of analytical data, preparation of reports, meetings with client and applicable regulators to review work and needs.

11/1989 - 06/1997
Geologist, IT Corporation, Albuquerque, New Mexico

Planning, site supervision, reporting.

Professional Affiliations

Geological Society of America, Professional Member, none, 2004
American Institute of Professional Geologists, Registered Member, none, 2002
Northern California Geological Society, Regular Member, President, 2007-2009, 2000

Barbara A. Matz

Title: Scientist 4
Employee Number: [redacted]
Location: Concord, CA
Location2:
Business Unit: Fed AS&E West, Home
Company: Shaw Environmental, Inc

Contact Information

Work Phone: 925-288-2337
Cell Phone: 415-713-8482

Skills

Group: FIELD SERVICES SPECIALTIES
Category: DRILLING
Skill/Experience Level: Borings : Working Knowledge
Skill/Experience Level: Drilling : Working Knowledge
Skill/Experience Level: Geoprobe : Working Knowledge
Skill/Experience Level: Monitoring Well Installation : Working Knowledge
Category: SAMPLING
Skill/Experience Level: Asbestos : Fundamental Knowledge
Skill/Experience Level: Drilling : Working Knowledge
Skill/Experience Level: Drums : Fundamental Knowledge
Skill/Experience Level: Sampling : Working Knowledge
Skill/Experience Level: Soil : Working Knowledge
Skill/Experience Level: Underground Storage Tanks : Working Knowledge
Skill/Experience Level: Wipe : Working Knowledge
Category: UNDERGROUND STORAGE TANKS
Skill/Experience Level: Cleaning : Fundamental Knowledge
Skill/Experience Level: Closure : Working Knowledge
Skill/Experience Level: Removal : Working Knowledge
Skill/Experience Level: Testing : Fundamental Knowledge

Group: TECHNICAL SPECIALTIES
Category: GEOLOGY
Skill/Experience Level: Engineering Geology : Fundamental Knowledge
Skill/Experience Level: Fault Studies : Working Knowledge
Skill/Experience Level: Geologic Studies : Working Knowledge
Skill/Experience Level: Geological Age Dating : Working Knowledge
Skill/Experience Level: Geophysical Survey : Fundamental Knowledge
Skill/Experience Level: Geotechnical Studies : Fundamental Knowledge
Skill/Experience Level: Remote Sensing : Working Knowledge
Skill/Experience Level: Seismicity Evaluation : Fundamental Knowledge
Skill/Experience Level: Structural Geology : Working Knowledge
Skill/Experience Level: Structural Mapping : Working Knowledge
Category: SITE INVESTIGATION
Skill/Experience Level: Aerial Photography Interpretation : Working Knowledge
Skill/Experience Level: Borehole Television : Fundamental Knowledge

Skill/Experience Level: Excavation of Test Pits/Trenches : Working Knowledge
Skill/Experience Level: Ground Penetrating Radar : Fundamental Knowledge
Skill/Experience Level: Groundwater Monitoring/Recovery Well Installation: Working Knowledge
Skill/Experience Level: Permeability Testing : Fundamental Knowledge
Skill/Experience Level: RCRA Facility Investigation : Working Knowledge
Skill/Experience Level: Remedial Action Plan : Working Knowledge
Skill/Experience Level: Remedial Investigation : Working Knowledge
Skill/Experience Level: RI/FS : Working Knowledge
Skill/Experience Level: Risk Assessment : Fundamental Knowledge
Skill/Experience Level: Site Investigation : Working Knowledge
Skill/Experience Level: Subsurface Investigation : Working Knowledge
Skill/Experience Level: Test Pits : Working Knowledge
Skill/Experience Level: Topographic Survey : Working Knowledge
Skill/Experience Level: Trenching : Working Knowledge
Category: WATER RESOURCES
Skill/Experience Level: Limnology : Fundamental Knowledge
Skill/Experience Level: Storm Water Management : Fundamental Knowledge
Skill/Experience Level: Water Quality : Fundamental Knowledge
Skill/Experience Level: Wells : Working Knowledge

Other Information

Years of Experience

Previous Employers: 0.00
CB&I: 25.25
Total of 25.25 year(s) experience

Experience in EPA Regions

Region 6 (AR LA NM OK TX)
Region 8 (CO MT ND SD UT WY)
Region 9 (AZ CA HI NV American Samoa, Guam, TT)

Industry Experience

Environmental

(b) (6) [redacted]

(b) (6) [redacted]

U.S. ARMY CORPS OF ENGINEERS

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HUNTSVILLE, ALABAMA

NAVFAC

CERTIFICATE

Barbara Matz

SW9-02-17-00348

has completed the Corps of Engineers and Naval Facility Engineering Command Training Course

CONSTRUCTION QUALITY MANAGEMENT FOR CONTRACTORS - #784

Concord, California	10/19/17 - 10/20/17	SW9 - NAVFAC Southwest	Michael Haliburton PMP, PE
Location	Training Date(s)	Instructional District/ NAVFAC	CQM-C Manager
Kugan Panchadsaram PE	kugan@kugan.com	858-212-2941	
Facilitator/Instructor	Email	Telephone	Facilitator/Instructor Signature

THIS CERTIFICATE EXPIRES FIVE YEARS FROM DATE OF ISSUE
CQM-C Recertification online course: https://www.myuln.net

Jeffrey D. Dziedzic

Chief, USACE Learning Center
Jeffrey D. Dziedzic

Last Updated: 24Mar2017

Kevin J. O'Leary

Professional Qualifications
Kevin J. O'Leary
Professional Qualifications

Mr. O'Leary has over twenty-nine years of professional experience working on a variety of government and commercial environmental investigation/remediation projects. Past experience includes serving as project manager, field manager, technical engineering/scientist lead, construction quality manager and site safety officer for large and small government and commercial remedial investigation/feasibility study and site remediation projects, providing project management for the removal and disposition of low-level radiological and mixed waste at a University of California research facility, conducting investigation and remediation of facilities at high-profile United States National Parks and California State Parks, field and technical oversight for EPA Superfund Sites, and feasibility analysis of project plans, adherence to strict quality assurance/quality control and health and safety programs and hydro-geologic data collection, interpretation and report writing.

Mr. O'Leary has gained extensive experience supervising drilling (direct push, hollow stem auger, dual-tube percussion, resonant sonic, mud rotary and air rotary-casing hammer methods) and well installations at government and commercial projects. He has also provided field management and technical oversight for the installation /operations/maintenance of direct and recirculating bio-injection groundwater treatment systems, soil vapor extraction (SVE) treatment systems, aboveground storage tank (AST), underground storage tank (UST), fuel pipeline and oil-water separator removals, the characterization, excavation and proper disposal of hazardous materials, the closure of RCRA Class 1 landfill facilities and CERCLA sites, the coordination and execution of sampling and analysis plans and as a liaison with local, state, and federal regulatory agencies.

Currently, Mr. O'Leary serves with CB&I Federal Services L.L.C. as Site Superintendent, Quality Control Manager and Site Safety Officer for the Remedial Action at Installation Restoration Site 17, NASA Crows Landing Flight Facility, Crows Landing, California while supporting government and commercial client projects as a project hydrogeologist, project manager, field operations manager, construction quality manager and site safety officer.

Education
Bachelor of Science, Physical Science-Hydrology, California State University-Chico, Chico, California, [redacted]

Additional Training/Continuing Education
US Army Corps of Engineers-Construction Quality Management (CQM) Training, Sacramento, CA, 2015
Site Safety Officer Training, Findlay, OH, 2011
Construction Site Supervisor Training, Findlay, OH, 2011

US Army Corps of Engineers-Construction Quality Management (CQM) Training, Concord, CA, 2010
Bay Area Refinery Process Safety Orientation Program-Bay Area Training Corporation (BATC) , Martinez, CA, 2004
Excavation Competent Person Training, 29 CFR 1910.120, Martinez, CA, 1998
Nuclear Density Gauge Operator Training, 49 CFR 172H, Martinez, CA, 1998
Radiation Worker II Training, 29 CFR 1910.120, Davis, CA, 1997
Project Management Training , Martinez, CA, 1994 and Concord, CA, 2010
Principles of Integrated Solid Waste Management, UC Berkeley, 1993
Hazardous Materials in Groundwater: Hydrology, Monitoring, and Remediation, UC Berkeley, 1992
Confined Space/Qualified Person Training, 29 CFR 1910.120 , Martinez, CA, 1992
Hazardous Waste Supervisor Training, 29 CFR 1910.120 , Martinez, CA, 1992
40 Hour OSHA Hazardous Materials Health and Safety Training, 29 CFR 1910.120 (updated annually), Martinez, CA, 1988

Registrations/Certifications/Licenses

USACE Construction Quality Control Manager, 2015, Active, Nationwide, 03/20/2020
First Aid and CPR - Basic, 1988, Active, Nationwide, 04/2017
Radiological Worker Level II, 1997, Inactive, Nationwide, 05/2004
Cert Hazardous Waste Supervisor-OSHA/19CFR1910.120, 1992, Active, Nationwide
Certified HAZWOPER, 1988, Active, Nationwide
Competent Person/Drilling Oversight (CPDO), 2002, Active, Nationwide
Construction Site Safety Supervisor, 2011, Active, Nationwide
Excavation Competent Person, 1998, Active, Nationwide
Nuclear Soil Gauge, 1998, Active, Nationwide

(b) (6) [redacted]

Experience and Background

05/2002 – present
Project Manager/Field Site Manager, CB&I Federal Services, L.L.C. (CB&I) and Shaw Environmental & Infrastructure, Inc., Concord, California

Responsibilities include providing support to government and commercial client projects and office staff as a Project Manager/Field Site Manager. Also responsible for business development and managing and contributing to project proposals.

The following is a summary of key projects:
Site Superintendent, Quality Control Manager and Site Safety Officer, Remedial Action at Installation Restoration Site 17, NASA Crows Landing Flight Facility, Crows Landing, CA, 500289, NAVFAC, Crows Landing, CA, $8,000,000, 05/2015 – present.
Field Site Manager/Superintendent, Quality Control Manager Site Safety Officer at the NASA Crows Landing Flight Facility, Crows Landing, CA, Installation Restoration Site 17 – Remedial Action in Crows Landing, CA. Currently providing Field Management and serving as Quality Control Manager and Site Safety Officer for the installation, operations and maintenance of the Recirculating Bio Injection Groundwater Treatment System.

Field Site Manager/Superintendent and Site Safety Officer, Former Naval Weapons Station - Detachment Concord, Concord, CA, Installation Restoration Site 29 Source Area – Non-Time Critical Removal Action for Groundwater and Soil Gas Remediation, 147615, NAVFAC, Concord, CA, $10,000,000.00, 10/2013 – 01/2015

Field Site Manager/Superintendent and Site Safety Officer at the NAVFAC Former Naval Weapons Station - Detachment Concord, Concord, CA, Installation Restoration Site 29 Source Area – Non-Time Critical Removal Action for Groundwater and Soil Gas Remediation project in Concord, CA. Currently providing Field Management, Technical Oversight and serving as Site Safety Officer of Direct Push Drilling/Bio Injection for the Groundwater Remediation task and providing Field Management, Technical Oversight and Site Safety Officer duties of Hollow Stem Auger Well Drilling and Soil Gas Extraction System construction for the Soil Gas Remediation task.

Accomplishments:
Zero lost work day incidents. Zero vehicle accidents.
Completed work scopes under budgets.

Awards/Client Commendations:
Client letters of commendation.

Field Project Manager/Technical Lead/Site Safety Officer, Aerojet, 134058, Aerojet-General Corporation, Sacramento/Rancho Cordova, CA, $1,000,000.00, 03/2013 – 04/2014

Field Project Manager, Technical Lead and Site Safety Officer for Aerojet-General Corporation's Field Environmental Restoration Program in Sacramento/Rancho Cordova, CA. Responsibilities require the management and technical leadership of tasks related to the groundwater, surface water, soils/sediments and soil vapor remedial investigations being conducted at the Prairie City State Vehicular Recreation Area and Barton Ranch for Aerojet's Boundary Operable Unit-Site 39 Additional Investigation.

Accomplishments:
Zero lost work day incidents. Zero vehicle accidents.
Completed work scopes under budgets.

Awards/Client Commendations:
Client letters of commendation.

Project Manager, Kato Road L.L.C., 775929, Landbank, Fremont, CA, $2,000,000.00, 06/2002 – 04/2014

Conduct Groundwater Monitoring Program and provide site closure consulting.

Accomplishments:
Completed work scopes under budgets.
Assisted negotiations to reduce Groundwater Monitoring Program frequency and site closure.
Annual Contract Extensions.

Awards/Client Commendations:
Client letters of commendation.

Assistant Task Manager/Cost and Schedule Analyst/Assistant Construction Quality Manager/Technical Lead and Assistant Site Safety Officer, Fort Ord-Monterey, CA, Lead

Removal, Munitions and Explosives of Concern (MEC) Field Reconnaissance, Munitions and Explosives of Concern (MEC) Removal and Operable Unit Carbon Tetrachloride Plume (OUCTP) projects, 846075 and 141234, US Army Corps of Engineers (USACE), Fort Ord-Monterey, CA, approximately $20,000,000.00, 11/2009 - 09/2010
Performed Assistant Task Management, Cost and Scheduling, Construction Quality Management, Technical Lead and Site Safety Officer functions for the US Army Corps of Engineers' Total Environmental Restoration Contract (TERC) Fort Ord-Monterey, CA Lead Removal, Munitions and Explosives of Concern (MEC) Removal and Operable Unit Carbon Tetrachloride Plume (OUCTP) projects.

Accomplishments:
Zero lost work day incidents. Zero vehicle accidents.
Completed work scopes under budgets.
Contributed to Fort Ord project receiving Shaw President's Award for achieving 5,000 days without a lost workday incident.

Project Manager, Orton Development, 779332, Orton Development, Hayward, CA, $100,000.00, 06/2002 - 04/2014
Conduct Groundwater Monitoring Program and provide site closure consulting.

Accomplishments:
Zero lost work day incidents. Zero vehicle accidents.
Completed work scopes under budgets.
Annual contract extensions.

Field Project Manager/Technical Lead/Site Safety Officer, Aerojet, 127495, 134058, Aerojet-General Corporation, Sacramento/Rancho Cordova, CA, $16,000,000.00, 08/2005 - 06/2010
Field Project Manager, Technical Lead and Site Safety Officer for Aerojet-General Corporation's Field Environmental Restoration Program in Sacramento/Rancho Cordova, CA. Responsibilities required the management and technical leadership of tasks related to the groundwater, surface water, soils/sediments and soil vapor remedial investigations being conducted at multiple sites for Aerojet's Boundary, Island and Eastern Operable Units. Also contributed on Aerojet's Boundary, Island and Eastern Operable Units RI/FS reports.

Accomplishments:
Zero lost work day incidents. Zero vehicle accidents.
Completed work scopes under budgets.
Annual contract extensions.

Awards/Client Commendations:
Client letters of commendation.

Project Manager/Technical Lead, Travis Air Force Base, 133028, United States Air Force/AFCEE, Travis, CA, $86,000.00, 11/2008 - 05/2009
Project Manager and Technical Lead for the Site Characterization at Facility 1514 and Reservoir 1518 Hydroflousalic Acids Spill at Travis AFB.

Accomplishments:
Zero lost work day incidents. Zero vehicle accidents.

Completed work scopes on schedule and under budgets.

Awards/Client Commendations:
Client letters of commendation

Project Manager, Laboratory for Energy-Related Health Research (LEHR), 770529, DOE-Oakland/Weiss Associates, Davis, CA, $14,000,000.00, 06/1997 - 11/2007
Managed multiple tasks related to the $14 million, performance-fee-driven, Environmental Restoration/Waste Management project at the United States Department of Energy's (DOE) former Laboratory for Energy-Related Health Research (LEHR) facility at the University of California, Davis.
Provided management, cost analysis, staff and technical supervision, oversight of project subcontractor contracts and providing the interface and coordination necessary to accomplish Shaw Environmental & Infrastructure commitments that were an essential contribution to a team of three contractors that are working together to meet the Department of Energy's aggressive overall project goals. The removal and disposal of laboratory-related radiological waste (Ra-226, Sr-90, Co-60, H-3, Pu-241, Am-241) and mixed waste from disposal trenches and septic systems, the decontamination and demolition of radiation contaminated facilities, the inventory, survey and shipment of radioactive biological wastes and radiological sources and standards to disposal facilities and the investigation and survey of potentially radiological contaminated facilities (Imhoff Ra-226/Sr-90 Treatment System, Mixed Waste Storage Facility, Western Dog Pens) and environmental conditions (Southwest Trenches waste burial site) are among the ongoing/completed tasks during this period.

Accomplishments:
Awarded over $500K (over 95%) of available project Performance Incentive Fees.
Zero lost work day incidents. Zero vehicle accidents.

Awards/Client Commendations:
Awarded over $500K (over 95%) of available project Performance Incentive Fees.
Client Health and Safety performance awards.

Project Manager, Lawrence Livermore National Laboratory (LLNL), 109575, University of California, Livermore, CA, $150,000.00, 04/2004 - 07/2005
Project Manager for Low Level/Mixed Waste Technical Support for the University of California at Lawrence Livermore National Laboratory

Accomplishments:
Contract extended in November 2004

Awards/Client Commendations:
Client letters of commendation.

05/2002 - present
Project Engineer/Scientist IV-Hydrogeologist, CB&I Federal Services, L.L.C. (CB&I) and Shaw Environmental & Infrastructure, Inc., Concord, California

Responsibilities include providing technical support to government and commercial client projects and office staff as a Project Hydrogeologist. Also responsible for business development and managing and contributing to project proposals.

The following is a summary of key projects:

Field Operations/Technical Oversight and Sample Coordinator, Yerington, NV, Field Operations/Technical Oversight and Sample Coordination at the Former Atlantic Richfield Company (ARC) Yerington-Anaconda Mine Site, Yerington, NV, 89447, US Environmental Protection Agency-San Francisco, CA. 02/2016 – present.
Field Operations/Technical Oversight and Sample Coordination

Field Operations/Technical Oversight and Sample Coordinator, Sunnyvale CA, Indoor and Outdoor Air Sampling Oversight at The Companies Offsite Operable Unit of the Triple Site, Sunnyvale, California, 500291, US Environmental Protection Agency-San Francisco, CA. 01/2015-10/2016.
Indoor and Outdoor Air Sampling Oversight and Sample Coordination

Project Hydrogeologist, DLA Energy-Fort Hood 2014 Fuel Spill Investigation and Recovery, 500238, US Army, Fort Hood-Killeen, TX , 10/2014-12/2014
Project Hydrogeologist/Drilling Rig Supervisor/Sample Coordinator

Project Hydrogeologist, Vandenberg AFB-Lompoc, CA, Installation Restoration Program -Site 3 and 50 Draft Groundwater Monitoring and Remedial Action Optimization Status Report, 01/2013 – 06/2014
Coauthor of Site 3 and 50 Draft Groundwater Monitoring and Remedial Action Optimization Status Reports for the Vandenberg AFB-Lompoc, CA, Installation Restoration Program

Project Hydrogeologist, Vandenberg AFB-Lompoc, CA, Installation Restoration Program – Site 60 Draft Groundwater Monitoring and Remedial Action Optimization Status Report, 03/2013
Author of Site 60 Draft Groundwater Monitoring and Remedial Action Optimization Status Report for the Vandenberg AFB-Lompoc, CA, Installation Restoration Program.

Project Hydrogeologist, Edwards AFB-Air Force Research Laboratory Groundwater Tracer Test for Bioremediation Feasibility, 146185, AFCEE, Edwards AFB, CA, 01/2013-03/2013
Project Hydrogeologist for the drilling and well installations at the Edwards AFB-Air Force Research Laboratory Groundwater Tracer Test for Bioremediation Feasibility. Performed Groundwater Tracer Test and data analysis for Bioremediation Feasibility.

Accomplishments:
Zero lost work day incidents, Zero vehicle accidents.

Wellsite/Operations Hydrogeologist, Intrepid Potash – New Mexico, L.L.C. HB In-Situ Project, 124303 and 146979, Intrepid Potash, Eddy County-Carlsbad, NM, 05/2012-10/2012
Wellsite/Operations Hydrogeologist for the drilling and well installations at the Intrepid Potash in-situ potash solution mining project in Eddy County-Carlsbad, NM.
Conducted geologic logging of mud rotary/reverse circulation drilling method boreholes and supervised drill crews, geophysical logging, casing and liner installations, design and pumping of cement jobs and well completions associated with the installation of high capacity brine injection and production wells. Advised on casing failures, fish jobs, circulation losses, gas kicks and selection of BHA’s and drilling muds. Identified formation changes/tops and bottoms that aided in final well installation designs. Responsible for drill crew and visitor Health and Safety at drill sites.

Accomplishments:
Zero lost work day incidents, Zero vehicle accidents by crews and visitors at supervised drill sites.

Field Task Manager/Technical Lead/Report Coauthor, BLM/Fort Ord Reconnaissance-Site Assessments, 846075, 141234, USACE, Fort Ord-Monterey, CA, 09/2010 - 01/2012
Field Task Manager and Technical Lead for the Reconnaissance-Site Assessments of Bureau of Land Management (BLM) Areas at the Former Fort Ord-Monterey, CA.
The Reconnaissance-Site Assessments of four (4) BLM areas totaling approximately 5,000 acres each consisted of either visual and/or instrument-aided field investigations to map site features that may have been related to past military training activities, map munitions and explosives of concern (MEC), map the path walked and identify subsurface anomalies where a magnetometer (Schonstedt GA-52/CX and EM-61) was used. Responsibilities included walking over 300 linear miles of regulatory agency preplanned routes, written and photo documentation of findings, data processing and coauthor of the Site Assessment Data Reports for each of the BLM areas.

Accomplishments:
Zero lost work day incidents, Zero vehicle accidents.
Contributed to Fort Ord project receiving Shaw President's Award for achieving 5,000 days without a lost workday incident.
Completed Reconnaissance-Site Assessments and Reports on schedule and within budgets.

Project Hydrogeologist, Dugway Proving Ground, 870502, US Army, Dugway, UT, 06/2004 - 10/2004
Performed as Project Hydrogeologist, Drilling Rig Supervisor and Sample Coordinator for monitoring well installation and soil/groundwater sample collection of deep borings at HWMU 55 and HWMU 58.
Coordinated storage, characterization and disposition of Investigation Derived Waste materials.

Project Hydrogeologist, Alameda Point, 101643, US Navy, Alameda, CA, 03/2004 - 10/2004
Technical Lead for the location and site characterization of approximately 500 linear feet of Industrial Waste Pipeline at IWTP 25.
Authored project plans and SOWs, performed as Project Hydrogeologist and Drilling Rig Supervisor for soil/groundwater sample collection from soil borings at former Industrial Waste Treatment Plants (IWTPT) at Buildings 25 and 32. Contributed as author for the project technical report.

Accomplishments:
Contributed to Alameda Point project receiving Shaw President's Award for achieving 1,500 days without a lost workday incident.

Project Hydrogeologist, Sandia National Laboratory-Bldg 913 Soil Sampling, 777674, Sandia National Laboratory, Livermore, CA, 02/2003 - 08/2003
Authored project plans and SOWs. Performed as Technical Lead, Project Hydrogeologist and Drilling Rig Supervisor for soil/groundwater sample collection from soil borings at Bldg 913. Contributed as author for the project technical report.

Accomplishments:
Zero lost work day incidents, Zero vehicle accidents.
Completed work scopes under budgets.

08/2011 - Present
Site Safety Officer, Chicago Bridge & Iron Company (CB&I) and Shaw Environmental & Infrastructure, Inc., Concord, California

Responsibilities include providing Site Safety oversight for government and commercial client projects.

Key projects:

Remedial Action at Installation Restoration Site 17, NASA Crows Landing Flight Facility, Crows Landing, CA, 500289, NAVFAC, Crows Landing, CA, 05/2015 – present.

Former Naval Air Station Moffett Field, Moffett Field, CA – Combined Enhanced Anaerobic Bioremediation (EAB) / In Situ Chemical Reduction (ISCR) Treatability Study at the Former Traffic Island Area of Installation Restoration Program Site 28, CTO-0104, 500238, 10/2014 – 05/2016.

Former Naval Weapons Station - Detachment Concord, Concord, CA, Installation Restoration Site 29 Source Area – Non-Time Critical Removal Action for Groundwater and Soil Gas Remediation, 147615, 10/2013 – 01/2015.

Former Naval Air Station Moffett Field, Moffett Field, CA – Supplemental Investigation, Former Building 88 and Traffic Island Areas – Installation Restoration Program Site 28, CTO-0046, 144002, 08/2013 – 02/2014

Aerojet-General Corporation, Sacramento/Rancho Cordova, CA, Boundary Operable Unit - Site 39 Additional Investigation, 134058, 08/2005 – 10/2013

Edwards AFB-Air Force Research Laboratory Groundwater Tracer Test for Bioremediation Feasibility, 146185, AFCEE, Edwards AFB, CA, 01/2013-03/2013

Fort Ord-Monterey, CA, US Army Corps of Engineers (USACE), Munitions and Explosives of Concern (MEC) Field Reconnaissance, 09/2010 - 01/2012

Fort Ord-Monterey, CA, US Army Corps of Engineers (USACE), Lead Removal, 11/2009 - 09/2010

11/2009 - Present
Construction Quality Control Manager, Chicago Bridge & Iron Company(CB&I) and Shaw Environmental & Infrastructure, Inc., Concord, California

Responsibilities include Construction Quality Control Management for government and commercial client projects. Includes managing quality aspects of field construction, field technical, analytical data, cost/schedule activities and technical report review.

Key projects:

Remedial Action at Installation Restoration Site 17, NASA Crows Landing Flight Facility, Crows Landing, CA, 500289, NAVFAC, Crows Landing, CA, 05/2015 – present.

Former Naval Air Station Moffett Field, Moffett Field, CA – Combined Enhanced Anaerobic Bioremediation (EAB) / In Situ Chemical Reduction (ISCR) Treatability Study at the Former Traffic Island Area of Installation Restoration Program Site 28, CTO-0104, 500238, 10/2014 – 05/2016.

Former Moffett Field, Moffett Field, CA – Supplemental Investigation, Former Building 88 and Traffic Island Areas – Installation Restoration Program Site 28, CTO-0046, 144002, 08/2013 – 02/2014

Former Naval Weapons Station - Detachment Concord, Concord, CA, Installation Restoration Site 29 Source Area – Non-Time Critical Removal Action for Groundwater and Soil Gas Remediation, 147615, 10/2013

Vandenberg AFB-Lompoc, CA, Installation Restoration Program -Site 24 Draft Groundwater Monitoring and Remedial Action Optimization Status Report, 07/2013

Vandenberg AFB-Lompoc, CA, Installation Restoration Program-Site 24 Draft Feasibility Study Report, 04/2012

Vandenberg AFB-Lompoc, CA, Installation Restoration Program-Site 50 Draft Feasibility Study Report, 03/2012

Fort Ord-Monterey, CA, US Army Corps of Engineers (USACE), Munitions and Explosives of Concern (MEC) Field Reconnaissance, 09/2010 - 01/2012

Fort Ord-Monterey, CA, US Army Corps of Engineers (USACE), Lead Removal, 11/2009 - 09/2010

05/1997 - 05/2002
Project Manager, IT Corporation (The Shaw Group Inc. acquired substantially all of the operating assets of the IT Group Inc. in May 2002), Martinez, California

Responsibilities included providing support to government and commercial client projects and office staff as a Project Manager. Also responsible for business development and managing and contributing to project proposals.

The following is a summary of key projects:
Project Manager, Laboratory for Energy-Related Health Research (LEHR), 770529, DOE-Oakland/Weiss Associates, Davis, CA, $7,000,000.00, 06/1997 - 05/2002
Managed multiple tasks related to the $14 million, performance-fee-driven, Environmental Restoration/Waste Management project at the United States Department of Energy's (DOE) former Laboratory for Energy-Related Health Research (LEHR) facility at the University of California, Davis.
Provided management, cost analysis, staff and technical supervision, oversight of project subcontractor contracts and providing the interface and coordination necessary to accomplish Shaw Environmental & Infrastructure commitments that are an essential contribution to a team of three contractors that are working together to meet the Department of Energy's aggressive overall project goals. The removal and disposal of laboratory-related radiological waste (Ra-226, Sr-90, Co-60, H-3, Pu-241, Am-241) and mixed waste from disposal trenches and septic systems, the decontamination and demolition of radiation contaminated facilities, the inventory, survey and

shipment of radioactive biological wastes and radiological sources and standards to disposal facilities and the investigation and survey of potentially radiological contaminated facilities (Imhoff Ra/Sr Treatment System, Mixed Waste Storage Facility, Western Dog Pens) and environmental conditions (Southwest Trenches waste burial site) are among the ongoing/completed tasks during this period.

01/1988 - 05/2002
Project Engineer/Scientist I, II, III-Hydrogeologist, IT Corporation, Martinez, California

Responsibilities included providing support to government and commercial client projects and office staff as a Project Hydrogeologist. Also responsible for business development and managing and contributing to project proposals.

The following is a summary of key projects:
<u>Lead Hydrogeologist, Mather Air Force Base, US Air Force (AFCEE), Sacramento, CA, $17,800,000.00, 01/1993 - 12/1994</u>
Lead Hydrogeologist/Project Management Staff, Additional Field Investigation (AFI), Mather Air Force Base (AFB), Sacramento, California 1993-1994).
Responsible for providing technical oversight and supervision for the field investigation associated with the fixed-price $17.8-million AFCEE Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) RI/FS project. These responsibilities included technical oversight and supervision for a field staff of up to 25 associates during drilling operations as well as management, scheduling, and oversight of project subcontractors and their contracts. The investigation required accessing the subsurface with air rotary/casing hammer (ARCH), mud rotary, dual-tube percussion, hollow-stem auger and sonic core drilling methods. The borehole geophysical logging methods of spontaneous potential, resistivity, nuclear (natural gamma, gamma-gamma and neutron) and sonic were used locate areas (aquifers) of high subsurface contaminant transport. Upon completion of the field investigation, was responsible for providing evaluation and interpretation of soil and groundwater chemical data for presentation in the AFI RI report. The AFI project was successful in its task of delineating groundwater and soil contaminant (vinyl chloride, DCE, TCE, PCE, JP-4, diesel, gasoline, and BTEX) plume boundaries in the vicinity of Mather AFB.

Accomplishments:
Greatly contributed to $17.8M fixed-price project being completed in under $10.0M resulting in approximately $7.8M company profit.

<u>Lead Hydrogeologist, Mather Air Force Base, US Air Force (AFCEE), Sacramento, CA, $6,000,000.00, 06/1992 - 12/1992</u>
Lead Field Hydrogeologist, Group 3 RI/FS Project, Mather AFB, Sacramento, California (June 1992-December 1992).
Provided technical oversight and supervision for the field investigation associated with the $6-million AFCEE CERCLA RI/FS project. This position included technical oversight of drilling operations and supervision for a field staff of up to ten associates as well as management, scheduling, and oversight of project subcontractors and their contracts.

<u>Lead Hydrogeologist, Mather Air Force Base, US Air Force (AFCEE), San Francisco, 12/1991 - 06/1992</u>
CERCLA Quarterly Monitoring Report, Mather AFB, Sacramento, California (December 1991-June 1992).

Preparation and submittal of the Mather AFB CERCLA quarterly monitoring report for AFCEE. Provided evaluation, interpretation, and presentation of contract laboratory analytical results and groundwater hydrogeologic data collected during Mather AFB quarterly groundwater sampling events. The Mather AFB CERCLA quarterly monitoring report provides an historical summary of Mather AFB groundwater contamination as well as providing a background to support future Mather AFB technical/management decisions.

<u>Lead Hydrogeologist, Mather Air Force Base, US Air Force (AFCEE), Sacramento, CA, 08/1990 - 02/1991</u>
Lead Field Hydrogeologist/Project Management Staff, RI/FS and SWAT Project, Mather AFB, Sacramento, California (1990-1991).
Provided technical oversight and supervision for the field investigation associated with the AFCEE CERCLA RI/FS and SWAT project. This included drilling operations, technical oversight and supervision for a field staff of up to ten associates, and management, scheduling, and oversight of project subcontractors and their contracts.

<u>Project Hydrogeologist, McClellan AFB, US Air Force (AFCEE), Davis, CA, 12/1989 - 04/1990</u>
Field Hydrogeologist, RI/FS Project, McClellan AFB, Davis, California (1988-1990).
Provided technical oversight and supervision for the field investigation associated with the AFCEE RI/FS project. This included drilling operations, aquifer testing, technical oversight and supervision for a field staff of up to ten associates, and management, scheduling, and oversight of project subcontractors and their contracts.

<u>Project Hydrogeologist, Castle Air Force Base, US Air Force (AFCEE), Atwater, CA, 06/1988 - 03/1990</u>
Field Hydrogeologist, RI/FS Project, Castle AFB, Atwater, California (1988-1990).
Provided technical oversight and supervision for the field investigation associated with the AFCEE RI/FS project. This included drilling operations, aquifer testing, technical oversight and supervision for a field staff of up to ten associates, and management, scheduling, and oversight of project subcontractors and their contracts.

<u>Project Hydrogeologist, Champion International, Champion International, Salinas, CA, 10/1987 - 04/1989</u>
Engineer/Scientist I, IT Corporation, Martinez, California.
As assistant project hydrogeologist/sample coordinator at the Champion International Groundwater Treatment Facility in Salinas, California, coordinated groundwater monitoring sampling and analysis program (SAP) for the industrial site remediation projects. Responsibilities also included collecting monitoring well and treatment plant samples, maintaining and operating treatment plant, conducting pump test aquifer studies, performing hydrogeologic data interpretation, contributing to the location, design, and installation of the intermediate aquifer groundwater extraction well system, performing monitoring well installation and abandonment; and serving as agricultural, domestic, industrial, and municipal well owner liaison.

<u>Project Hydrogeologist, Firestone, Firestone, Salinas, CA, 10/1987 - 04/1989</u>
Engineer/Scientist I, IT Corporation, Martinez, California
As assistant project hydrogeologist/sample coordinator at the Firestone Groundwater Treatment Facility in Salinas, California, coordinated groundwater monitoring sampling and analysis program (SAP) for the industrial site remediation projects. Responsibilities also included collecting monitoring well and treatment plant samples, maintaining and operating treatment plant, conducting pump test aquifer studies, performing hydrogeologic data interpretation, contributing to the location, design, and installation of the intermediate aquifer groundwater

extraction well system, performing monitoring well installation and abandonment; and serving as agricultural, domestic, industrial, and municipal well owner liaison.

01/1994 - 06/1997
Task Manager, IT Corporation, Martinez, California

Responsibilities include providing support to government and commercial client projects and office staff as a Task Manager. Also responsible for business development and managing and contributing to project proposals.

The following is a summary of key projects:
<u>Task Manager, Presidio of San Francisco,, United States Army Corps of Engineers (USACE), San Francisco, CA, $10,000,000.00, 03/1996 - 06/1997</u>
As Task Manager of the $10 million United States Army Corps of Engineers (USACE) Fuel Distribution System (FDS). For the FDS Removal project at the Presidio of San Francisco National Park, was responsible for managing a technical and labor force of up to 40 associates to remove and dispose of over 40,000 linear feet of FDS pipeline and its associated petroleum-impacted (petroleum hydrocarbons, heating oil, BTEX) soils. Project responsibilities included cost analysis, technical oversight and supervision for a technical and labor force of up to 40 associates, as well as management, scheduling, oversight of project subcontractors and their contracts, and coordination and scheduling of removal operations to comply and cooperate with ongoing Presidio of San Francisco National Park Service (NPS) activities

<u>Task Manager, Mather Air Force Base, , US Air Force (AFCEE), Sacramento, CA, $8,000,000.00, 01/1995 - 06/1996</u>
Accomplished dual-role of Task Manager/Field Operations Coordinator for the $8 million AFCEE Additional Site Characterization (ASC) CERCLA RI/FS project at Mather AFB, Sacramento, CA. Position included managing a field staff of up to 20 associates, managing and overseeing project subcontractors and their contracts, performing Air Force/Client/Regulatory liaison, and QA/QC and Health and Safety program enforcement. Responsibilities also included generating bid proposals, writing work plans and assisting in the data evaluation and interpretation for proposed Mather AFB closure plans presented in the ASC report. The project accomplished AFCEE? s goal of locating the groundwater contaminants of concern (vinyl chloride, DCE, TCE, PCE, JP-4, diesel, gasoline, and BTEX) for future remediation. The characterization required accessing the subsurface with air rotary/casing hammer (ARCH), mud rotary, dual-tube percussion, hollow-stem auger and sonic core drilling methods. The borehole geophysical logging methods of spontaneous potential, resistivity, nuclear (natural gamma, gamma-gamma and neutron) and sonic were used locate areas (aquifers) of high subsurface contaminant transport.

Accomplishments:
Zero lost work day incidents. Zero vehicle accidents.

<u>Task Manager/Project Hydrogeologist, Northern California Hazardous Waste Disposal Sites, International Technology Corporation (IT Corp), Martinez, CA, 01/1994 - 01/1995</u>
Served as Project Hydrologist/Task Manager in the Northern California Sites Division, Groundwater Programs Group. Managed Comprehensive Groundwater Monitoring Evaluation (CME) and Class 1 landfill closure projects in compliance with California Department of Toxic Substances Control (DTSC) regulations. Position required continual hydrogeologic data monitoring and interpretation and report writing in a support of this division's efforts to close four Northern California area Class 1 landfill facilities under RCRA.

Accomplishments:
1994 National Quality Award

01/1991 - 12/1996
Field Operations Coordinator, IT Corporation, Martinez, California

Responsibilities include providing support to government and commercial client projects and office staff as a Field Operations Coordinator.

The following is a summary of key projects:
<u>Field Operations Coordinator, Mather Air Force Base,, US Air Force (AFCEE), Sacramento, CA, $1,000,000.00, 01/1992 - 12/1992</u>
Field Operations Coordinator/Lead Geologist, Project Management Staff, Mather AFB Landfill Gas Operable Unit/FS project in Sacramento, California Responsible for coordinating all aspects of the field investigation associated with the $1-million AFCEE landfill gas OU/FS project. Managed a field staff of up to 15 associates, managed and oversaw project subcontractors and their contracts, performed Air Force/client/regulatory liaison, and enforced QA/QC and Health and Safety program enforcement. Responsibilities also included generating bid proposals, writing work plans, and assisting in data evaluation and interpretation for the Mather AFB proposed landfill closure plans presented in the landfill gas OU/FS report.

<u>Field Operations Coordinator, Mather Air Force Base,, US Air Force (AFCEE), Sacramento, CA, $20,000,000.00, 11/1990 - 03/1991</u>
Field Operations Coordinator/Project Management Staff, Group 2 RI/FS and Solid Waste Water Quality Assessment Test (SWAT) Projects, Mather AFB, Sacramento, California
Responsible for coordinating all aspects of the field investigation associated with the $20-million AFCEE CERCLA RI/FS and SWAT projects. Position responsibilities included managing a field staff of up to 20 associates, managing and overseeing project subcontractors and their contracts, serving as Air Force/client/regulatory agency liaison, and enforcing QA/QC and health and safety programs. Responsibilities also included generating bid proposals, writing work plans, and providing hydro-geologic data evaluation, interpretation, and presentation for CERCLA RI/FS reports.

01/1987 - 06/1989
Sample Coordinator, IT Corporation, Martinez, California

Responsibilities include providing support to government and commercial client projects and office staff as a Sample Coordinator.

The following is a summary of key projects:
<u>Sample Coordinator, Firestone, Firestone, Salinas, CA, 10/1987 - 04/1989</u>
Engineer/Scientist I, IT Corporation, Martinez, California
As assistant project hydrogeologist/sample coordinator at the Firestone Groundwater Treatment Facility in Salinas, California, coordinated groundwater monitoring sampling and analysis program (SAP) for the industrial site remediation projects. Responsibilities also included collecting monitoring well and treatment plant samples, maintaining and operating treatment plant, conducting pump test aquifer studies, performing hydrogeologic data interpretation, contributing to the location, design, and installation of the intermediate aquifer groundwater extraction well system, performing monitoring well installation and abandonment; and serving as agricultural, domestic, industrial, and municipal well owner liaison.

<u>Sample Coordinator, Champion International, Champion International, Salinas, CA, 10/1987 - 04/1989</u>
Engineer/Scientist I, IT Corporation, Martinez, California
As assistant project hydrogeologist/sample coordinator at the Champion International Groundwater Treatment Facility in Salinas, California, coordinated groundwater monitoring sampling and analysis program (SAP) for the industrial site remediation projects. Responsibilities also included collecting monitoring well and treatment plant samples, maintaining and operating treatment plant, conducting pump test aquifer studies, performing hydrogeologic data interpretation, contributing to the location, design, and installation of the intermediate aquifer groundwater extraction well system, performing monitoring well installation and abandonment; and serving as agricultural, domestic, industrial, and municipal well owner liaison.

05/1985 - 08/1987
Firefighter, US Forest Service, Mendocino County, California

Wild lands Firefighter

The following is a summary of key projects:
<u>Firefighter, Wild lands Fire, Mendocino National Forest, CA, Western United States, 05/1985 - 10/1988</u>
US Forest Service Firefighter throughout the Western United States.

01/1986 - 06/1987
Sample Coordinator, Butte County Planning Department, Oroville, California

Responsibilities include coordinating and collecting groundwater samples from domestic water wells as part of the Butte County Planning Department’s groundwater study.

The following is a summary of key projects:
<u>Sample Coordinator, Butte County Aquifer Study, Butte County Planning Department, Oroville, CA, 12/1986 - 06/1987</u>
Responsibilities include coordinating and collecting groundwater samples from domestic water wells as part of the Butte County Planning Department’s groundwater study.

Awards/Honors

President's Safety Award, Shaw Environmental and Infrastructure, Inc., 2010
President's Award, Shaw Environmental and Infrastructure, Inc, 2004
LEHR Project Health and Safety Award, Weiss Associates, 1999
Health and Safety-3rd Quarter 1995, International Technology Corporation, 1995
National Quality Award-Northern California Sites Groundwater Group, International Technology Corporation-Quality and Health Services, 1994
National Quality Award-Firestone Project, Salinas, CA, International Technology Corporation-Quality and Health Services, 1988

Publications/Presentations

Kevin O'Leary, William Schaal, Survival Techniques for Subcontractors, Association of Engineering Geologists 46th Annual Meeting, Vail, CO, 2003

Kevin O'Leary, William Schaal, Douglas Brown, Innovative Radioactive Contamination Controls in Rapid Site Assessments, University of Massachusetts 14th Annual Conference on Contaminated Soils, October 1998, Amherst, MA, 1998

Other Information

Languages
Language: Speak Read Write
Spanish: Moderate, Slight, Slight

Years of Experience
Previous Employers: 1.00
CB&I: 27
Total of 28.00 year(s) experience

Experience in EPA Regions
Region 5 (IL IN MI MN OH WI)
Region 9 (AZ CA HI NV American Samoa, Guam, TT)

Industry Experience
Environmental

(b) (6) [redacted]

(b) (6) [redacted]

U.S. ARMY CORPS OF ENGINEERS

USACE LEARNING CENTER
HUNTSVILLE, ALABAMA

NAVFAC

CERTIFICATE

KEVIN J. O'LEARY

#SPK511501065

has completed the Corps of Engineers and Naval Facility Engineering Command Training Course

CONSTRUCTION QUALITY MANAGEMENT FOR CONTRACTORS - #784

SACRAMENTO, CA	3/19-3/20/15	SACRAMENTO/SPK	DREW A. PERRY
Location	Training Date(s)	Instructional District/ NAVFAC	CQM-C Manager

DREW A. PERRY	DREW.A.PERRY@USACE.ARMY.MIL	(916) 557-7779	
Facilitator/Instructor	Email	Telephone	Facilitator/Instructor Signature

THIS CERTIFICATE EXPIRES FIVE YEARS FROM DATE OF ISSUE

Director, USACE Learning Center

Michael R. Lightner

Cell: 530-941-3738
Email: michael.lightner@aptim.com

Professional Qualifications

Mr. Lightner has over twelve years of professional experience working on various government and commercial environmental investigation and remediation projects throughout the continental United States. Past experience includes acting as site supervisor, technical lead, field manager, project geophysicist, project geologist, and site safety and health officer. Throughout his career, Mr. Lightner has developed a diverse skill set, and has provided hands-on experience in the form of technical oversight and implementation, coordination, and management.

Education

Bachelor of Science, Geology, University of California, Davis, Davis, California, [redacted]
Associate of Arts, General Education, Shasta College, Redding, California, [redacted]

Additional Training

8 Hour OSHA Hazardous Waste Operations Refresher, Aptim, 2017
Construction Quality Management for Contractors, CB&I Federal Services LLC, 2017
30 Hour OSHA Construction Safety Training, CB&I Federal Services LLC, 2016
Radiation Worker Training, CB&I Federal Services LLC, Naval Station Treasure Island, 2016
First Aid/CPR Training, CB&I Federal Services LLC, 2016
Radiation Worker Training, CB&I Federal Services LLC, Hunters Point Naval Shipyard, 2016
8 Hour OSHA Site Supervisor Training, CB&I Federal Services LLC, 2014
UXO/MEC Awareness Training, CB&I, Vandenberg Air Force Base, 2013
40 Hour MSHA Hazard Training, Zonge Geosciences, 2006
40 Hour OSHA Hazardous Waste Operations, Aerotek Engineering & Environmental, 2005

Experience and Background

01/2007 - Present

Scientist 2, APTIM (formerly CB&I Federal Services LLC), Concord, California

Mr. Lightner has acted as project geophysicist in a field supervisory role on various geophysical surveys, including unexploded ordnance surveys, utility location & clearance surveys, and seismic and resistivity surveys. Mr. Lightner has worked as a geologist, using various methods (including Air Rotary Casing Hammer, Mud Rotary, Hollow Stem Auger, Direct Push and Sonic) to install groundwater monitoring wells, soil vapor wells, and soil vapor extraction systems. Mr. Lightner has performed soil, soil vapor, and water sampling. Additionally, Mr. Lightner has acted as Technical Lead on a large scale Military Munitions Response Program project, the responsibilities for which consisted of the following: technical writing for documents such as Work Plans, After Action Reports, Explosives Siting Plans, Weekly and Daily Reports, and proposal and procurement documents; managing the excavation and transportation and disposal of lead impacted soil from a Small Arms Range; organizing short term and long term logistics in order to complete project work on time and on budget; managing field employees, including accompanying administrational tasks; working directly with USAF and USACE clients on a daily basis.

The following is a summary of key projects:

<u>Site Supervisor, Project Geologist/Geophysicist, Marine Corps Mountain Warfare Training Center, Bridgeport, CA, 05/2017-Present</u>
Landfill condition and capping assessment activities in support of landfill closure.

<u>Project Geologist, Marine Corps Base Camp Pendleton, CA, 03/2017-Present</u>
Installation of groundwater bioventing/biosparging system, and enhanced in situ bioremediation activities.

Site Supervisor, Site Safety and Health Officer, Naval Air Weapons Station China Lake, Ridgecrest, CA, 09/2016 – 12/2016
Visual Site Inspections at the Salt Wells Propulsion Lab in support of RCRA Facility Assessment.

Site Supervisor, Project Geologist, NASA Crows Landing Flight Facility, Crows Landing, CA, 06/2016-Present
Groundwater characterization and remediation through enhanced in situ bioremediation with recirculation, combined with monitored natural attenuation.

Project Geologist, Hunters Point Naval Shipyard, San Francisco, CA, 09/2015 - Present
Groundwater characterization and remediation through in situ bioremediation and soil vapor extraction.

Technical Lead, Vandenberg Air Force Base, Lompoc, CA, 04/2011 - 12/2015
Munitions and explosives of concern interim removal action at Vandenberg AFB in support of the USAF Military Munitions Response Program.

Awards/Client Commendations:
Project received "Exceptional" evaluation rating from USACE on Contractor Performance Assessment Reports.

Project Geophysicist, Fort Ord, Monterey, CA, 01/2007 - 04/2011
Investigation and cleanup of unexploded ordnance and military munitions.

Awards/Client Commendations:
Received Personal Choice Award, 2009.

Project Geophysicist/Geologist, Aerojet, Rancho Cordova, CA, 01/2007 - 01/2009
Groundwater investigation and characterization through groundwater and soil vapor monitoring.

12/2005 - 12/2006
Exploration Geophysicist, Zonge Geosciences, Sparks, Nevada
Various geophysical field surveys, including Induced Polarization and Controlled Source Audio-Frequency Magnetotellurics, in order to locate and/or track large deposits of ore, namely gold.

06/2005 - 12/2005
Field Technician, Aerotek Engineering and Environmental, Sacramento, California
Investigation and cleanup of unexploded ordnance and military munitions; contracted by Zonge Geosciences.

Summary of key projects:
Field Technician, Beale Air Force Base, Marysville, CA, 06/2005 - 12/2005

Accomplishments:
Sole field technician hired on by Zonge Geosciences at the completion of the project.

Publications
Martin Miele, Jeremy Flemmer, Tom Dobecki, Sandra Takata, Michael Lightner, *Synergistic Geophysical Techniques for Assessing Seepage Pathways in Earthen Levees*, Symposium on the Application of Geophysics to Engineering and Environmental Problems, Denver, CO, 2009

Languages
Spanish, moderate

U.S. ARMY CORPS OF ENGINEERS

USACE LEARNING CENTER
HUNTSVILLE, ALABAMA

NAVFAC

CERTIFICATE

Michael Lightner

SPK-USACE-02-17-00051

has completed the Corps of Engineers and Naval Facility Engineering Command Training Course

CONSTRUCTION QUALITY MANAGEMENT FOR CONTRACTORS - #784

San Diego, CA	3/8/2017- 3/9/2017	SPK-USACE	Jonathan Revolinsky
Location	Training Dates	Instructional District/ NAVFAC	CQM-C Manager

Larry Smith	Jonathan.Revolinsky@usace.army.mil	916-557-7779	
Facilitator/Instructor	Email	Telephone	Facilitator/Instructor Signature

THIS CERTIFICATE EXPIRES FIVE YEARS FROM DATE OF ISSUE

Chief, USACE Learning Center

Last Updated: 05 Apr 2017

Amy C. Meldrum

Professional Qualifications

Ms. Meldrum has over two years of environmental consulting experience. She has analyzed radiological data and developed reports in support of designating materials as non-low-level radioactive waste. She has also analyzed radiological scan data to support efforts to identify and locate subsurface radioactive objects. She has also modeled various types of TENORM waste for worker risk assessment and landfill acceptance. She has also assisted as a technical reviewer of radiological waste packages for transuranic waste destined for WIPP. Additionally, Ms. Meldrum has been involved in projects associated with Environmental Impact Statements, Historical Site Assessments, EPA technical reports, and NIOSH EEOICPA Dose Reconstruction Technical Basis Documents. She has several years experience using radiological modeling codes and software, and has passed Part I of the ABHP Health Physicist Exam.

Education

Master of Science, Environmental Engineering - Environmental Health Physics, Clemson University, Clemson, South Carolina, [redacted]
Bachelor of Engineering, Nuclear Engineering and Radiological Sciences, University of Michigan, Ann Arbor, Michigan, [redacted]

Additional Training/Continuing Education

Construction Quality Management for Contractors - #784, Colorado Springs, CO, 2016
FEMA IS-00003 Radiological Emergency Management, Vienna, VA, 2015
FEMA IS-00027 Orientation to FEMA Logistics, Vienna, VA, 2015
FEMA IS-00100.b Introduction to Incident Command System, Vienna, VA, 2015
FEMA IS-00120.a An Introduction to Exercises, Vienna, VA, 2015
FEMA IS-00130 Exercise Evaluation and Improvement Planning, Vienna, VA, 2015
FEMA IS-00230.d Fundamentals of Emergency Management, Vienna, VA, 2015
FEMA IS-00235.b Emergency Planning, Vienna, VA, 2015
FEMA IS-00301 Radiological Emergency Response, Vienna, VA, 2015
FEMA IS-00331 Introduction to Radiological Emergency Preparedness Exercise Evaluation, Vienna, VA, 2015
FEMA IS-00700.a National Incident Management System (NIMS) An Introduction, Vienna, VA, 2015
FEMA IS-00800.b National Response Framework, An Introduction, Vienna, VA, 2015
FEMA IS-00836 Nuclear/Radiological Incident Annex, Vienna, VA, 2015
24-Hour HAZWOPER, Vienna, VA, 2015
40-Hour MARSSIM Course, Oak Ridge, TN, 2015
American Board of Health Physics - Health Physics Exam Part 1, Baltimore, MD, 2014

Registrations/Certifications/Licenses

Construction Quality Management (CQM), 2016, Active, Nationwide, 11/2021

Experience and Background

10/2016 - Present
Project Scientist 3, CB&I Federal Services, Technical Services, Greenwood Village, Colorado

Analyzed radiological data for determination of Non-LLRW for soil and concrete materials, and to support the identification of subsurface radioactive objects, and prepared reports for these data. Modeled oil and gas field waste with TENORM for risk assessments and landfill acceptance, and assisted in the preparation of related technical documents.

The following is a summary of key projects:

Project Scientist, Alameda Building 5, 500519, Department of the Navy, Alameda, CA, 02/2017 - Present
Modeled the project scenario using the EPA Building Preliminary Remediation Goals (BPRG) Calculator to calculate Derived Concentration Guidelines.

Project Scientist, TI Site 12 TCRA/Kleinfelder, 500565, Kleinfelder, Treasure Island, CA, 11/2016 - Present
Review radiological data and prepare data packages for the release of concrete and soils as non-LLRW materials.

Project Scientist, Treasure Island Basewide, 500505, Department of the Navy, Treasure Island, CA, 10/2016 - Present
Analyzed previously collected radiological data to aid in the identification of subsurface radioactive objects.

01/2015 - 10/2016
Health Physicist, SC&A, Inc., Vienna, Virginia

Modeled oil and gas TENORM wastes for landfill acceptance and risk assessments. Provided technical support in the review of radiological documentation of wastes destined for WIPP for technical adequacy and completeness. Assisted in the development of various sections of an Environmental Impact Statement for an In-Situ Leach Uranium Mine in Wyoming, including socioeconomic and radiological impacts. Assisted in the review of technical basis documents used in dose reconstructions under the NIOSH EEOICPA program. Assisted in the development of EPA documents related to TENORM wastes. Developed a Historical Site Assessment for an EPA facility to be decommissioned.

Professional Affiliations

American Board of Health Physicists, Associate Member, 2014
Health Physicst Society, Member, 2012

Amy C. Meldrum

Title: Project Scientist 3
Employee Number: [redacted]
Location: Greenwood Village, CO
Location2: Village Center Station
Business Unit: RAD Safety, Home
Company: APTIM Federal Services

Contact Information

Work Phone: 3034862560

Skills
Group: COMPUTER/INFORMATION TECHNOLOGY SPECIALTIES
Category: COMPUTER APPLICATIONS (User)
Skill/Experience Level: Adobe Acrobat : Working Knowledge
Skill/Experience Level: Adobe Illustrator : Fundamental Knowledge
Skill/Experience Level: GIS : Fundamental Knowledge
Skill/Experience Level: Internet : Working Knowledge
Skill/Experience Level: Microsoft Access : Fundamental Knowledge
Skill/Experience Level: Microsoft Excel : Working Knowledge
Skill/Experience Level: Microsoft Outlook: Working Knowledge
Skill/Experience Level: Microsoft Power Point : Working Knowledge
Skill/Experience Level: Microsoft Word : Working Knowledge
Skill/Experience Level: Windows Vista: Working Knowledge
Skill/Experience Level: Windows XP : Working Knowledge
Category: COMPUTER/GENERAL
Skill/Experience Level: Computers (desktops/laptops) : Working Knowledge

Group: CONSULTING SPECIALTIES
Category: ASSESSMENT/EVALUATION
Skill/Experience Level: Environmental Impact Statement : Fundamental Knowledge
Skill/Experience Level: Radiological Surveys : Working Knowledge
Category: HOMELAND SECURITY
Skill/Experience Level: Radiation Detection : Working Knowledge
Skill/Experience Level: Radiation Survey : Working Knowledge

Group: ENVIRONMENTAL SPECIALTIES
Category: ANALYTICAL
Skill/Experience Level: Data Management : Fundamental Knowledge
Category: REGULATORY
Skill/Experience Level: Clean Air Act : Fundamental Knowledge
Skill/Experience Level: Clean Water Act : Fundamental Knowledge
Skill/Experience Level: Code of Federal Regulations : Fundamental Knowledge
Skill/Experience Level: NEPA Compliance : Fundamental Knowledge
Skill/Experience Level: Nuclear Regulatory Commission : Fundamental Knowledge

Group: FIELD SERVICES SPECIALTIES
Category: SAMPLING
Skill/Experience Level: Air : Fundamental Knowledge
Skill/Experience Level: Sampling : Fundamental Knowledge
Skill/Experience Level: Soil : Fundamental Knowledge
Skill/Experience Level: Wipe : Fundamental Knowledge

Group: TECHNICAL SPECIALTIES
Category: HEALTH AND SAFETY
Skill/Experience Level: Health Physics : Working Knowledge
Category: MODELING
Skill/Experience Level: Air Dispersion Modeling : Fundamental Knowledge
Skill/Experience Level: Exposure Modeling : Fundamental Knowledge
Skill/Experience Level: Mathematical Modeling : Fundamental Knowledge
Category: NUCLEAR/RADIOLOGY
Skill/Experience Level: Analysis : Working Knowledge
Skill/Experience Level: Decontamination and Demolition : Fundamental Knowledge
Skill/Experience Level: Low-Level Radiation : Fundamental Knowledge
Skill/Experience Level: Radiation Detection : Working Knowledge
Skill/Experience Level: Radiation Dosimetry : Working Knowledge
Skill/Experience Level: Radiation Protection Training : Fundamental Knowledge
Skill/Experience Level: Radiation Risk Assessment : Fundamental Knowledge
Skill/Experience Level: Radiation Shielding Design : Fundamental Knowledge
Skill/Experience Level: Radiation Transportation Regulations : Fundamental Knowledge
Skill/Experience Level: Radioactive Safety/Monitoring : Fundamental Knowledge
Skill/Experience Level: Radioactive Waste Management : Fundamental Knowledge
Skill/Experience Level: Radiological Surveys : Working Knowledge

Other Information

Years of Experience

Previous Employers: 1.75
CB&I: 1
Total of 2.75 year(s) experience

U.S. ARMY CORPS OF ENGINEERS

USACE LEARNING CENTER
HUNTSVILLE, ALABAMA

NAVFAC

CERTIFICATE

Amy Meldrum

NWO-71-16-00210

has completed the Corps of Engineers and Naval Facility Engineering Command Training Course

CONSTRUCTION QUALITY MANAGEMENT FOR CONTRACTORS - #784

Colorado Springs, CO	November 9 2016	NWO - Omaha District	Louis Richardson
Location	Training Date(s)	Instructional District/ NAVFAC	CQM-C Manager
Chip L Kossow	chip.l.kossow@usace.army.mil	719-526-5448	
Facilitator/Instructor	Email	Telephone	Facilitator/Instructor Signature

THIS CERTIFICATE EXPIRES FIVE YEARS FROM DATE OF ISSUE
CQM-C Recertification online course: https://www.myuln.net

Jeffrey D. Dziedzic
Chief, USACE Learning Center
Jeffrey D. Dziedzic

Attachment 5
Outside Organizations

Outside Organizations

Organization Name/Address/Phone	Description of Services
TestAmerica	Environmental Analytical Services
Cabrera Services, Inc.	Radiological technical support

Attachment 6
Submittal Register

SUBMITTAL REGISTER

CONTRACT NUMBER
N62473 15 D 0811
CTO N62473-17-F-4550

Title and Location: ***Radiological Work Tasks, Remedial Action and Maintenance of Remedies, Task: : Radiological Characterization Surveys, Parcel F Structures, Hunters Point Naval Shipyard, San Francisco, California***

Contractor
Aptim Federal Services LLC

Specification Section
Scope of Work

				Type of Submittal									Classification			Contractor Schedule Dates			Contractor Action			Government Action		
Transmittal No.	Item No.	Specification Paragraph No.	Description of Item Submitted	Data	Drawings	Instructions	Schedules	Statements	Reports	Certificates	Samples	Records	Information only	Government approved	Reviewer	Submit	Approval needed by	Material needed by	Code	Date	Submit to government	Code	Date	Remarks
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
	001	Section 2.1.1	Copy of NRC and CA License and SOPs					X		X			X											
	002	Section 2.2.1	Kickoff Meeting Minutes					X						X	RPM									Within 10 days of meeting
	003	Section 2.1.1	Monthly Status Reports					X					X		RPM									
	004	Section 2.0	Internal Draft Work Plan, SAP, CQC Plan, WMP		X		X	X						X	RPM									
	005	Section 2.0	Draft Work Plan SAP, CQC Plan, WMP		X		X	X						X	RPM									
	006	Section 2.0	Final Work Plan		X		X	X						X	RPM									
	007	Section 2.3.2.4	Draft Radiological Protection Plan		X			X						X	RASO									
	008	Section 2.3.2.4	Final Radiological Protection Plan		X			X						X	RASO									
	009	Section 2.3.2.1	Draft APP/SSHP		X			X						X	Navy NMPHC									
	010	Section 2.3.2.1	Final APP/SSHP		X			X						X	Navy NMPHC									
	011	Section 2.5.5	Internal Draft Characterization Survey Report – Parcel F Submarine Pens	X	X			X	X			X		X	RPM									
	012	Section 2.5.5	Draft Characterization Survey	X	X			X	X			X		X	RPM									

SUBMITTAL REGISTER	CONTRACT NUMBER N62473 15 D 0811 CTO N62473-17-F-4550
***Title and Location:* Radiological Work Tasks, Remedial Action and Maintenance of Remedies, Task: : Radiological Characterization Surveys, Parcel F Structures, Hunters Point Naval Shipyard, San Francisco, California** — Contractor Aptim Federal Services LLC	Specification Section Scope of Work

Transmittal No.	Item No.	Specification Paragraph No.	Description of Item Submitted	Type of Submittal: Data	Drawings	Instructions	Schedules	Statements	Reports	Certificates	Samples	Records	Classification: Information only	Government approved	Reviewer	Contractor Schedule Dates: Submit	Approval needed by	Material needed by	Contractor Action: Code	Date	Submit to government	Government Action: Code	Date	Remarks
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
			Report – Parcel F Submarine Pens																					
	013	Section 2.5.5	Draft Final Characterization Survey Report – Parcel F Submarine Pens	X	X			X	X			X		X	RPM									
	014	Section 2.5.5	Final Characterization Survey Report – Parcel F Submarine Pens	X	X			X	X			X		X	RPM									
	015	Section 2.5.5	Internal Draft Characterization Survey Report – Parcel F Finger Piers	X	X			X	X			X		X	RPM									
	016	Section 2.5.5	Draft Characterization Survey Report – Parcel F Finger Piers	X	X			X	X			X		X	RPM									
	017	Section 2.5.5	Draft Final Characterization Survey Report – Parcel F Finger Piers	X	X			X	X			X		X	RPM									
	018	Section 2.5.5	Final Characterization Survey Report – Parcel F Finger Piers	X	X			X	X			X		X	RPM									

Attachment 7
Testing Plan and Log

Testing Plan and Log

Contract No. N62473-17-D-0006 Contract Task Order N62473-17-F-4550			PARCEL F—Hunters Point Naval Shipyard San Francisco, California							Contractor APTIM	
Specification Section and Paragraph Number	Test Procedure	Test Name	Accredited/ Approved Laboratory		Sampled By	Location of Test On Site or Off Site		Frequency of Test	Date Completed	Date Forwarded to Contracting Officer	Remarks
			Yes	No							
*											

Notes:

** Analytical testing requirements are provided in the Sampling and Analysis Plan (Appendix A of the Work Plan).*

APTIM *Aptim Federal Services, LLC*

Attachment 8
Definable Features of Work Matrix

Definable Features of Work Matrix
CONTRACTOR QUALITY CONTROL PLAN—PARCEL F
Radiological Work Tasks, Remedial Action and Maintenance of Remedies
Hunters Point Naval Shipyard
San Francisco, California
Contract Number N62473-17-D-0006
Contract Task Order N62473-17-F-4550

Plan/ Specification Section	Schedule Cross Reference	Feature of Work	Task Lead	Preparatory	Initial	Follow-Up	Completion
Work Plan/7.1, 7.2	W.E. 4	Radiological Surveys of Parcel F Structures	Amy Meldrum	Lee Laws	Lee Laws	Amy Meldrum	Amy Meldrum
Work Plan/7.4	W.E. 4	Decontamination and Release of Equipment and Tools	Amy Meldrum	Lee Laws	Lee Laws	Amy Meldrum	Amy Meldrum
Work Plan/7.3, 7.5, 7.6	W.E. 4	Site Restoration/Demobilization	Amy Meldrum	Lee Laws	Lee Laws	Amy Meldrum	Amy Meldrum

Notes:

W.E. *work element*

Attachment 9
Organization and Personnel Certifications

Organization and Personnel Certifications Log
Definable Features of Work Matrix
CONTRACTOR QUALITY CONTROL PLAN—PARCEL F
Radiological Work Tasks, Remedial Action and Maintenance of Remedies
Hunters Point Naval Shipyard
San Francisco, California
Contract Number N62473-17-D-0006
Contract Task Order N62473-17-F-4550

Definable Feature of Work	Certification Requirement	Code	Organization	Individual	Verified by/Date Verified	Certificate Expires
All Project Tasks	40-Hour Occupational Safety and Health Administration Hazardous Waste Operations and Emergency Response, including 8-Hour Refresher, Radiological Worker Awareness Training	P	APTIM	(all personnel)		
Lab Analysis	U.S. Department of Defense Environmental Laboratory Accreditation Program	S				

Legend:

Column 1, Definable Feature of Work: Refer to Construction Quality Control Plan table for list of definable features of work. List in order.

Column 2, Certification Requirement: State the certification required for the subcontractor, supplier, and/or individual.

Column 3, Code: S = Certificate required for the firm, that is, subcontractor or supplier; P = certificate required for the person performing the work.

Column 4, Organization: Subcontractor or supplier organization name.

Column 5, Individual: Name of certified individual (note: if certification requirement only applies to the firm, note name of person who provided certificate).

Column 6, Verified By/Date Verified: APTIM individual who verified certificates for organization and/or individuals. Verification required no later than Preparatory Inspection.

Column 7, Certificate Expires: Note the certificate expiration date.

Notes:

This log will be included in the Construction Quality Control Plan as an appendix with Columns 1, 2, and 3 are filled in. Remaining columns will be completed when information becomes available.

APTIM Aptim Federal Services, LLC

Attachment 10
Procedures

(Procedures will be included if requirements for project-specific quality procedures arise as the project progresses)

Appendix C
Waste Management Plan

Naval Facilities Engineering Command Southwest
BRAC PMO West
San Diego, CA

APPENDIX C
FINAL
WASTE MANAGEMENT PLAN

Parcel F Structures

HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

July 2018

DCN: APTM-0006-4550-0025

Naval Facilities Engineering Command Southwest
BRAC PMO West
San Diego, CA

APPENDIX C
FINAL
WASTE MANAGEMENT PLAN

Parcel F Structures

HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

July 2018

Prepared for:

Department of the Navy
Naval Facilities Engineering Command Southwest
BRAC PMO West
33000 Nixie Way, Bldg. 50
San Diego, CA 92147

Prepared by:

Aptim Federal Services, LLC
4005 Port Chicago Highway, Suite 200
Concord, CA 94520

Contract Number: N62473-17-D-0006; Task Order: N62473-17-F-4550
DCN: APTM-0006-4550-0025

Naval Facilities Engineering Command Southwest
BRAC PMO West
San Diego, CA

APPENDIX C
FINAL
WASTE MANAGEMENT PLAN

Parcel F Structures

HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

July 2018

Lisa Bercik
Lisa Bercik, PE, QSD, QSP
Project Manager

July 3, 2018
Date

Contract Number: N62473-17-D-0006; Task Order: N62473-17-F-4550
DCN: APTM-0006-4550-0025

Table of Contents

List of Tables

List of Attachments

Acronyms and Abbreviations

APTIM	Aptim Federal Services, LLC
LLMW	low-level mixed waste
LLRW	low-level radiological waste
PPE	personal protective equipment
Navy	U.S. Department of the Navy
NRC	U.S Nuclear Regulatory Commission
T&D	transportation and disposal

1.0 Introduction

This Waste Management Plan was prepared and will be implemented by Aptim Federal Services, LLC (APTIM), under Contract No. N62473-17-D-0006, Contract Task Order N62473-17-F-4550. This document is submitted as Appendix C of the Work Plan.

This Waste Management Plan describes the categories of waste and project management and engineering controls that APTIM will use to accumulate, transport, and dispose of waste generated at the site in a cost-effective, timely, and compliant manner. Section 2.0 includes a summary of the types of waste expected to be generated when providing radiological support to the contractor performing work in radiologically impacted areas. It also provides specific waste information and the Transportation and Disposal (T&D) Coordinator's associated responsibilities for each T&D activity.

2.0 Waste Categories and Classification

This section describes the types of waste anticipated to be generated during the Parcel F radiological characterization surveys.

The APTIM Site Superintendent will ensure waste from different sources are segregated by each individual source. The T&D Coordinator will then review available information and determine whether the waste from different sources can be commingled for both cost and handling efficiency. Table 1 includes information regarding waste accumulation methods and times.

2.1 Solid Waste

Site activities will consist of radiological surveys and are not expected to generate significant quantities of waste. Waste generated during these activities will either be radiological or non-radiological in nature (Table 2 and Table 3). Practical measures will be implemented to minimize the generation of low-level radiological waste (LLRW; materials that contain radionuclides at greater than Hunters Point Action Levels) or low-level mixed waste (LLMW; waste containing both LLRW and levels of chemicals triggering a hazardous waste designation).

Non-radiological waste that are anticipated include, but are not limited to, the following:

- Refuse and debris
- Personal protective equipment (PPE)

LLRW or LLMW that is anticipated include, but are not limited to, the following:

- Discrete radiological point sources
- Radiologically contaminated soil/sediment
- Refuse and debris
- PPE
- Material and equipment used during the course of work.

2.2 Liquid Waste

Liquid waste is not expected to be generated during Parcel F activities.

3.0 Transportation and Disposal Activities

Non-radiological hazardous waste is not expected to be generated during Parcel F field activities. The following subsections address specific control and management practices for LLRW and LLMW. Waste characterization activities will include radiological screening of waste debris and other materials prior to final disposition. Surveys will follow APTIM's U.S. Nuclear Regulatory Commission (NRC) and/or California license procedures for free release. If classified as LLRW or LLMW, these wastes may be placed in containers provided by the U.S. Department of the Navy (Navy) LLRW waste broker. The Navy's LLRW waste broker will coordinate closely with the Navy's Radiological Affairs Support Office and be responsible for packaging, shipping, manifesting, and disposal of LLRW and LLMW.

3.1 Waste Classification

Radioactive waste will be classified as either LLRW or LLMW per NRC guidelines and/or disposal facility requirements. Waste characteristics, including the radionuclides present and their associated specific activity, will be measured using available standardized test methods such as those listed in Table 2.

3.2 Waste Accumulation and Storage

APTIM will segregate and accumulate wastes into the categories outlined in Table 2. The APTIM Site Superintendent will ensure wastes from different sources are segregated by each individual source. The APTIM T&D Coordinator will then review available information and determine whether the wastes from different sources can be commingled for both cost and handling efficiency.

Radiologically impacted soil and/or debris will be placed in covered and lined roll-off containers (or other suitable container) which will be provided by the Navy’s LLRW waste broker. The Navy’s LLRW waste broker will assign a unique identification number to each individual container and will supervise and manage the tracking and contents of each bin.

Attachment 1 provides the “Waste Inventory Log” that the APTIM Site Superintendent will use to track project waste. Attachment 2 provides the “Waste Storage Area Inspection Checklist” that the APTIM Site Superintendent will use to inspect each waste storage area on a weekly basis.

3.3 Labeling and Posting of Containers Containing Radioactive Waste

Each waste container containing LLRW will be labeled and placed in a designated radioactive material storage area. The waste container will be labeled with a “Caution—Radioactive Material” label. The label will also note the maximum surface radiation level (measured in microroentgen per hour). The waste inventories will be managed under APTIM’s NRC license until it is transferred to the Navy’s LLRW waste broker.

3.4 Waste Accumulation Areas

APTIM will implement, at a minimum, the following requirements for radioactive waste stored on site within a designated radiologically impacted area:

- Display an industry standard placard and barrier materials with wording that includes the following, “Caution, Radiologically Controlled Area, Radioactive Materials Area, RWP Required for Entry, Authorized Personnel Only” (written in English and Spanish), at each radiological storage area every 50 feet (or 15 meters). The signs will be legible.
- Aisle space will be maintained to allow for the unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment to any area of facility operation in an emergency.
- The areas will be secured to prevent unauthorized access to the material.
- The following emergency equipment will be located or available to personnel during active waste management activities at each accumulation area:
- A device, such as a telephone or a hand-held two-way radio, capable of summoning emergency assistance will be available.
- Portable fire extinguishers, fire control equipment, spill control equipment, and decontamination equipment will be available.

Filled containers generated during performance of this Work Plan will be stored at the site where they were generated until the contained material can be characterized for packaging and disposal by the waste broker.

3.5 Waste Minimization

To minimize the volume of waste streams generated during the project, the following general guidelines will be followed:

- Waste material will not be cross-contaminated unnecessarily.
- Work will be planned ahead.
- Material may be stored in large containers, but the smallest reasonable container will be used to transport the material to the location where it is needed.
- Cleaning and extra sampling supplies will be maintained outside any potentially contaminated area to keep them clean and to minimize additional waste generation.
- Mixing of detergents or decontamination solutions will be performed outside potentially contaminated areas.
- When decontaminating radioactively contaminated material, every effort should be made to minimize the generation of mixed waste.
- Drop cloths or other absorbent material will be used to contain small spills or leaks.
- Contaminated material will not be placed with clean material.
- Wooden pallets inside the exclusion zone will be covered with plastic.
- Material and equipment will be decontaminated and reused when practical.
- Volume reduction techniques will be used when practicable.
- Waste containers will be verified to ensure that they are solidly packed to minimize the number of containers.

3.6 Inspections

While waste accumulation areas will be informally inspected on a daily basis, formal inspections of radiological controlled areas under the APTIM NRC license will be inspected weekly. The Project Radiation Safety Officer or designee will conduct inspections. Inspections will be logged in a dedicated field notebook, and a weekly inspection checklist will be completed. The radiologically controlled areas will be inspected to ensure the following:

- The containers will be checked for good condition. If a container is not in good condition, the waste broker will be informed.
- The containers will be checked to ensure that they remain closed and secured at all times, except when adding or removing waste.

- The soil stockpiles will be checked to see they are properly identified/labeled and that their identification number is legible.
- The fence lines and gates will be checked for signs of break-ins or vandalism.

3.7 Waste Disposal

Radiological waste generated under this project will be disposed by the Navy's LLRW waste broker. These wastes may include the following:

- Debris, PPE, and soil classified as unsuitable for reuse as backfill, based on radiological analysis, will be directly loaded into bins and transferred to the Navy's LLRW waste broker for disposal. Bins will be provided by the Navy's LLRW waste broker.
- Non-hazardous debris and PPE not classified as radiologically impacted will be moved outside the radiologically controlled area following approval from Radiological Affairs Support Office.

4.0 References

California Code of Regulation, Title 22, Social Security, Division 4.5, "Environmental Health Standards for the Management of Hazardous Waste," Chapter 12, "Standards Applicable to Generators of Hazardous Waste," current.

Code of Federal Regulations, Title 40, Part 300, *National Oil and Hazardous Substances Pollution Contingency Plan*, U.S. Government Printing Office, Washington, D.C.

Tables

Table 1
Waste Accumulation Methods and Times

Waste	Accumulation Method	Maximum Accumulation Times
LLRW	Temporary waste pile; roll-off container	Not applicable for nonhazardous; 90 days maximum for hazardous according to 22 CCR Section 66262.34
Refuse and debris	Temporary waste pile; roll-off container	Not applicable for nonhazardous
PPE and Visqueen®	Roll-off container; plastic bag	Not applicable for nonhazardous; 90 days maximum for hazardous according to 22 CCR Section 66262.34

Notes:

California Code of Regulation (CCR), Title 22, Social Security; Division 4.5, Environmental Health Standards for the Management of Hazardous Waste; Chapter 12, Standards Applicable to Generators of Hazardous Waste; current through April 10, 2009.

LLRW — *low-level radiological waste*
PPE — *personal protective equipment*

Table 2
Waste Sample Types and Analyses

Waste	Sample Type	Analytical Methods
LLRW	Representative	Surface contamination and gamma scanning surveys Gamma spectroscopy for radium-226 and cesium-137 (EPA Method 901.1) Total strontium/strontium-90 (EPA Method 905.0/Sr-02) Plutonium-239 (DOE A-01-R) Other radionuclide-specific analyses as required
Refuse and debris	No sampling	N/A
PPE and Visqueen®	No sampling, PPE will be characterized based on associated materials	N/A

Notes:

California Code of Regulation (CCR), Title 22, Social Security; Division 4.5, Environmental Health Standards for the Management of Hazardous Waste; Chapter 12, Standards Applicable to Generators of Hazardous Waste; current through April 10, 2009.

DOE	*U.S. Department of Energy*
EPA	*U.S. Environmental Protection Agency*
LLRW	*low-level radiological waste*
N/A	*not applicable*
PPE	*personal protective equipment*

Table 3
Preliminary Characterization and Classification

Waste Stream	EPA/DTSC Characterization	DOT Classification
LLRW or LLMW	Class A LLRW	Class 7 or not regulated
Refuse and debris	Nonhazardous	Non-regulated
PPE and Visqueen®	Nonhazardous	Not applicable

Notes:

DOT	*U.S. Department of Transportation.*
DTSC	*California Department of Toxic Substances Control*
EPA	*U.S. Environmental Protection Agency*
LLMW	*low-level mixed waste*
LLRW	*low-level radiological waste*
PPE	*personal protective equipment*

Attachment 1
Waste Inventory Log

WASTE INVENTORY LOG

Aptim Federal Services, LLC
Contract No. N62473-15-D-0811 | Task Order N62473-17-F-4550
Hunters Point Naval Shipyard San Francisco, California

Date of Inventory Inspection: _____________ Inspected by: ____________________________

Manifest Number	Container Number	Container Type	Container Volume	Generation Date	Waste Description/ Originating Site	Date Removed from site

Attachment 2
Waste Storage Area Inspection Checklist

Waste Storage Area Inspection Checklist

Inspected by:____________________ Date:______________ Time: _____________

	Yes	No	Corrective Action	Date Corrected
Area posted with appropriate hazard and cautionary signs				
Area free of spills?				
All liquids stored in proper secondary containment?				
Secondary containment basins free of liquids, snow and debris?				
Containers compatible with waste being stored?				
Containers properly sealed (lids on, rings in place, bins covered, etc.)?				
All containers properly labeled?				
Labels easily visible for inspection?				
Accumulation start dates present on labels?				
Accumulation start dates with storage time limit (e.g., 90 days)?				
Information on all labels legible not faded and all required information is present?				
Adequate aisle space for drums (minimum 22 inches)?				
Aisles and doorways free of obstructions?				
Containers free of leaks, dents or deterioration including structural defects and rusting?				
Adequate separation of incompatible materials?				
Tops of containers free of standing water?				
Stockpiles adequately covered?				

Notes: ____

Appendix D
Gamma Scan Minimum Detectable Concentration Basis

Surface gamma scanning will be performed as part of the scoping survey of Parcel F structures. Scan surveys will be performed to identify areas of elevated gamma radiation that could result from potential contamination. The results of the surface gamma scan surveys will be used to identify locations of elevated gamma activity for additional investigation. This appendix describes the methods used to develop *a priori* scan minimum detectable concentrations (MDCs) for low-level radiological objects (LLROs) on the surface. This determination is used to support selection of instrumentation and measurement methods based on the project measurement quality objectives.

Two measurement systems will be used to perform surface gamma scan surveys for the Parcel F structures:

- A RS-700 scanning system operated as a towed array, and
- 3-inch by 3-inch thallium activated sodium iodide (3x3 NaI) detectors connected to a global positioning system (GPS).

Section 1 of the appendix discusses the field of view (FOV) for the Radiation Solutions Inc. (RSI) RS-700. Section 2 presents the assumptions and calculations for the RS-700 radium-226 (^{226}Ra) scan MDA for LLROs. Section 3 presents the assumptions and calculations for the 3x3 NaI scan ^{226}Ra MDA.

1.0 CLASS Field of View

The objective of this case study was to map the capability of the RS-700 and determine its FOV. Using a certified radium source, the FOV has been determined to be 3.57 square meters (m^2) or a circle with a diameter of 2.13 meters (m). A copy of the calibration certificate for the radium source used for this determination is shown in Figure 1.

1.1 DESCRIPTION OF CLASS

The RS-700 consists of an RS-701 integrated controller and data acquisition system, a digital gamma ray spectrometer/multi-channel analyzer (MCA), a data controller, two RSX-256 4-liter (256 cubic inch) thallium activated sodium iodide [NaI(Tl)] gamma scintillation detectors, an internal GPS, and an external high-resolution Trimble Pro XH GPS receiver.

The system is operated using the RSI "RadAssist" software, which displays real-time data collection, both as a sodium iodide (NaI) spectrum as well as the count rates. The system collects gross gamma counts in 1,024 energy spectral divisions. For the purposes of this test, only the gross gamma counts at a location were evaluated.

1.2 EXPERIMENTAL METHOD

Two gamma scintillation detectors as employed in the towed array and wall RS-700 orientations were placed in the center of radial matrix. The radial matrix was designed with a series of concentric rings with each ring one foot apart extending out seven feet from the center. The rings were further divided into 12 sectors plus the four cardinal compass points. The sectors and points were labeled with letters (i.e., A through P) and the concentric circles were labeled with numbers corresponding to the distance from the center. For example, cell A0 indicates the source was placed directly under the detector and A1 indicates the source was placed one foot away from the detector.

Isotope Products Laboratories

An Eckert & Ziegler Company

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661•309•1010
Fax 661•257•8303

CERTIFICATE OF CALIBRATION
GAMMA STANDARD SOURCE

Radionuclide:	Ra-226	**Customer:**	CABRERA SERVICES, INC.
Half-life:	1600 ± 7 years	**P.O. No.:**	06-064
Catalog No.:	EG-CUSTOM	**Reference Date:**	1-Sep-05 12:00 PST
Source No.:	1131-47-1	**Contained Radioactivity: (Ra-226 only)**	105.3 nCi 3896 Bq

Physical Description:

A. Capsule type:	Customer supplied canister (4.25" OD x 4.875" Ht)
B. Nature of active deposit:	Ra-226 distributed in 1.7 g/cc sand matrix
C. Active diameter/volume:	Approximately 800mL (1336 grams)
D. Backing:	Tin
E. Cover:	Tin

Radioimpurities:

None detected (daughters not in equilibrium as of 24-Aug-05)

Method of Calibration:

This source was prepared from a weighed aliquot of solution whose activity in µCi/g was determined using gamma ray spectrometry.

Peak energy used for integration:	186.0 keV
Branching ratio used:	0.0351 gammas per decay

Uncertainty of Measurement:

A. Type A (random) uncertainty:	± 1.0 %
B. Type B (systematic) uncertainty:	± 3.0 %
C. Uncertainty in aliquot weighing:	± 0.1 %
D. Total uncertainty at the 99% confidence level:	± 3.2 %

Notes:

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (as in NRC Regulatory Guide 4.15).
- Nuclear data was taken from NCRP Report No. 58, 1985.
- This source has a working life of 5 years.

Daniel James Van Delson
Quality Control

26-Aug-05
Date

IPL Ref. No.: 1131-47

ISO 9001 CERTIFIED

Medical Imaging Laboratory
24937 Avenue Tibbitts Valencia, California 91355

Industrial Gauging Laboratory
1800 North Keystone Street Burbank, California 91504

Figure 1. Radium Source Calibration Certificate

A National Institute of Standards and Technology (NIST) traceable radium source was placed on the grid cells and a one minute static measurement was collected. The radial matrix was 16 feet in diameter. Each row of data was calculated from all radial distance positions in a concentric ring. Figure 2 shows the layout for the experiment.

1.3 DATA RESULTS

A total of 124 one-minute static measurements were collected during this experiment. Two data sets were generated - one from each of the two detectors. The data were combined, and the combined data were evaluated and plotted using Surfer 8 software. A color-coded plot was used to identify elevated locations on the experimental grid. Table 1 provides a summary of the combined data set.

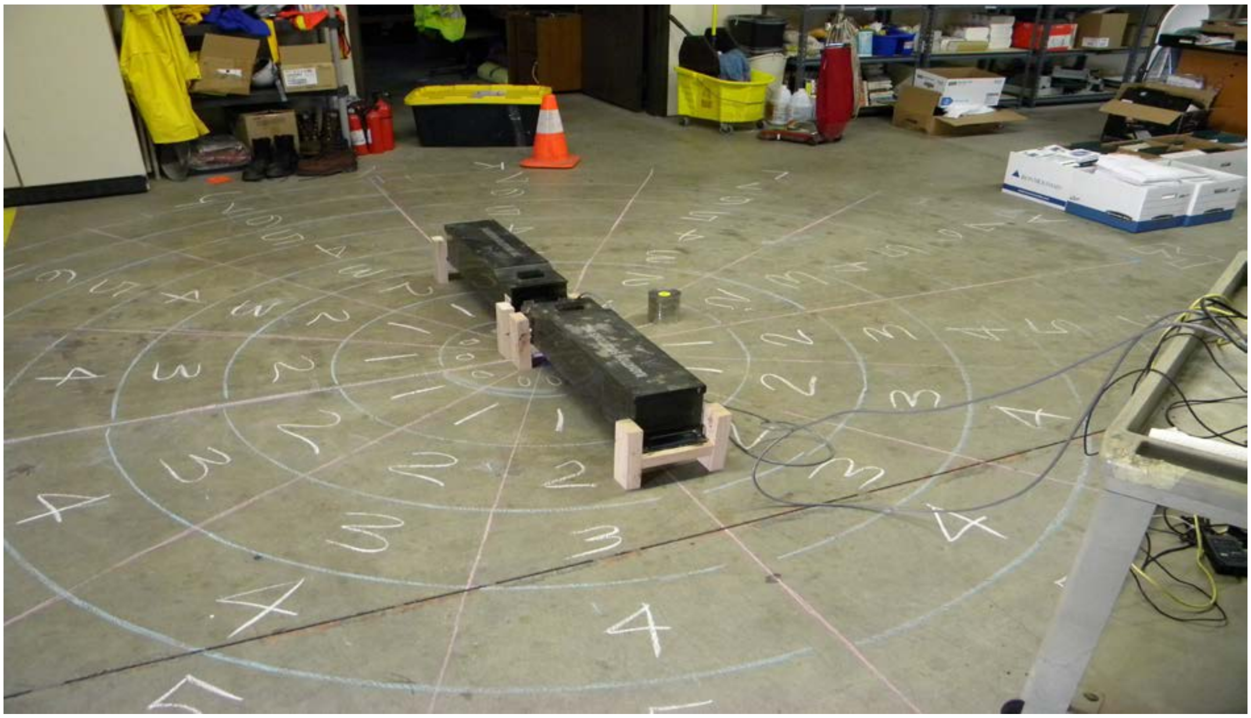


Figure 2. Radial Matrix Experimental Grid

Table 1. Data Summary

Sample Location	Detector 1 (cpm)	Detector 2 (cpm)	Combined (cpm)
A 00	134,917	123,771	258,688
A 01	119,753	114,464	234,217
A 02	121,543	118,050	239,593
A 03	116,464	112,693	229,157
A 04	115,664	111,675	227,339
A 05	114,870	110,943	225,813
A 06	115,280	111,505	226,785

Table 1. Data Summary (Continued)

Sample Location	Detector 1 (cpm)	Detector 2 (cpm)	Combined (cpm)
A 07	114,972	111,252	226,224
B 00	127,230	130,523	257,753
B 01	127,401	127,429	254,830
B 02	120,476	118,817	239,293
B 03	115,358	112,504	227,862
B 04	114,478	111,598	226,076
B 05	114,652	112,735	227,387
B 06	114,859	110,957	225,816
B 07	113,843	111,349	225,192
C 00	124,338	138,935	263,273
C 01	124,763	135,889	260,652
C 02	119,674	120,944	240,618
C 03	114,797	114,516	229,313
C 04	114,567	113,629	228,196
C 05	114,430	112,212	226,642
C 06	114,738	111,095	225,833
C 07	114,229	111,646	225,875
D 00	123,438	152,351	275,789
D 01	122,519	152,924	275,443
D 02	118,573	121,965	240,538
D 03	114,078	116,178	230,256
D 04	114,578	112,727	227,305
D 05	114,418	111,735	226,153
D 06	114,357	111,532	225,889
D 07	114,261	110,909	225,170
E 00	123,755	159,945	283,700
E 01	121,620	152,222	273,842
E 02	118,927	122,087	241,014
E 03	113,907	116,325	230,232
E 04	113,798	112,079	225,877
E 05	113,568	112,085	225,653
E 06	113,776	111,361	225,137

Table 1. Data Summary (Continued)

Sample Location	Detector 1 (cpm)	Detector 2 (cpm)	Combined (cpm)
E 07	113,637	110,862	224,499
F 00	123,661	143,954	267,615
F 01	123,979	136,795	260,774
F 02	119,145	121,458	240,603
F 03	114,378	113,778	228,156
F 04	113,254	112,406	225,660
F 05	113,565	111,040	224,605
F 06	113,904	110,839	224,743
F 07	113,671	110,571	224,242
G 00	126,472	131,903	258,375
G 01	126,541	127,310	253,851
G 02	119,687	118,839	238,526
G 03	114,870	112,618	227,488
G 04	114,176	112,054	226,230
G 05	114,055	111,394	225,449
G 06	113,739	111,535	225,274
G 07	114,080	111,470	225,550
H 00	136,724	122,837	259,561
H 01	130,161	122,115	252,276
H 02	122,228	117,107	239,335
H 03	116,388	111,733	228,121
H 04	114,950	111,887	226,837
H 05	114,210	111,105	225,315
H 06	114,174	111,451	225,625
H 07	113,993	111,173	225,166
I 00	149,801	120,112	269,913
I 01	136,145	120,505	256,650
I 02	123,694	116,926	240,620
I 03	116,805	111,317	228,122
I 04	115,449	111,283	226,732
I 05	113,946	111,222	225,168
I 06	114,493	111,661	226,154

Table 1. Data Summary (Continued)

Sample Location	Detector 1 (cpm)	Detector 2 (cpm)	Combined (cpm)
I 07	114,134	110,172	224,306
J 00	169,660	119,066	288,726
J 01	149,020	119,327	268,347
J 02	124,212	116,452	240,664
J 03	117,668	111,179	228,847
J 04	115,146	110,974	226,120
J 05	114,560	111,150	225,710
J 06	114,211	110,487	224,698
J 07	114,318	111,233	225,551
K 00	161,417	118,459	279,876
K 01	147,493	119,469	266,962
K 02	133,822	110,965	244,787
K 03	117,890	111,244	229,134
K 04	115,650	110,577	226,227
K 05	114,577	110,416	224,993
K 06	114,264	111,025	225,289
K 07	114,132	110,806	224,938
L 00	145,674	120,993	266,667
L 01	141,622	120,829	262,451
L 02	123,846	116,844	240,690
L 03	116,943	111,023	227,966
L 04	115,138	111,183	226,321
L 05	114,659	111,178	225,837
L 06	114,925	110,962	225,887
L 07	114,207	110,827	225,034
M 01	126,235	122,762	248,997
M 02	124,635	121,166	245,801
M 03	124,016	119,901	243,917
M 04	123,266	119,567	242,833
M 05	122,489	119,017	241,506
M 06	122,274	119,461	241,735
M 07	121,819	119,489	241,308

Table 1. Data Summary (Continued)

Sample Location	Detector 1 (cpm)	Detector 2 (cpm)	Combined (cpm)
N 01	122,759	156,139	278,898
N 02	122,602	147,986	270,588
N 03	122,560	123,868	246,428
N 04	122,401	120,519	242,920
N 05	121,122	118,824	239,946
N 06	121,282	118,932	240,214
N 07	121,308	118,675	239,983
O 01	125,958	121,637	247,595
O 02	124,454	120,957	245,411
O 03	122,993	120,068	243,061
O 04	122,855	119,211	242,066
O 05	122,533	118,803	241,336
O 06	121,450	119,530	240,980
O 07	121,848	119,225	241,073
P 01	159,942	118,242	278,184
P 02	139,992	118,448	258,440
P 03	125,955	118,459	244,414
P 04	122,278	118,748	241,026
P 05	122,065	118,247	240,312
P 06	121,392	118,050	239,442
P 07	121,712	118,224	239,936

Figure 3 provides a graphical presentation of the data. A dip in the detection is indicated on the three-dimensional side view plot that was artificially created due to the fact that the detector mounting stands precluded the ability of placing the source at the exact 0,0 location.

1.4 FINDINGS

The combined detector gross counts were used to determine the effective detector FOV to simulate the data analysis used for field operations. The data demonstrate the RS-700 with the two detectors arranged in a line have a FOV for detecting the radium source of 3.57 m^2. The FOV is essentially equal in the lateral (side to side) and vertical (front to back) directions at 7.0 feet (2.13 m) diameter. The detector response is 82 percent of the source emission rate at the periphery of the FOV relative to 100 percent at the center. This compares well to the minimum detectable activity calculated using the Microshield® computer code (Grove Engineering) where the exposure rate 50 centimeters (cm) offset from the end of the detector was 82.6 percent of the exposure rate directly under the detector.

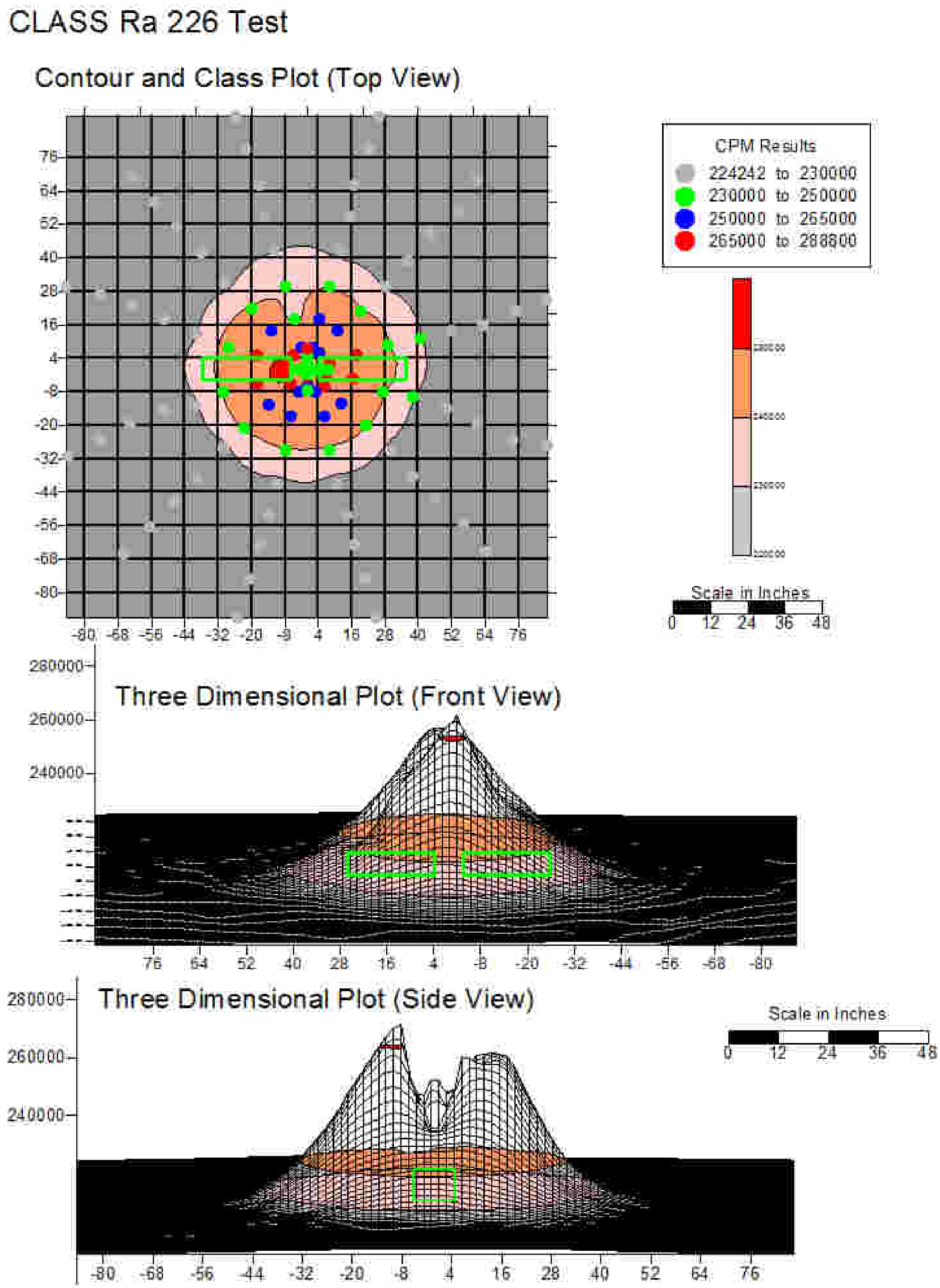


Figure 3. Graphical Data Display

2.0 RS-700 ^{226}RA SCAN MINIMUM DETECTABLE ACTIVITY FOR LLROs

2.1 INTRODUCTION

The surveys for this project will be performed using the RS-700 (two four-inch x four-inch x sixteen-inch NaI scintillation detectors—see Figure 5). Scans of the subject survey material will be accomplished at a maximum scan speed of 1.0 m/sec at a detector height of approximately 4 inches (10 cm) above the surface. Results will be tallied by counts within a one (1) second time interval.

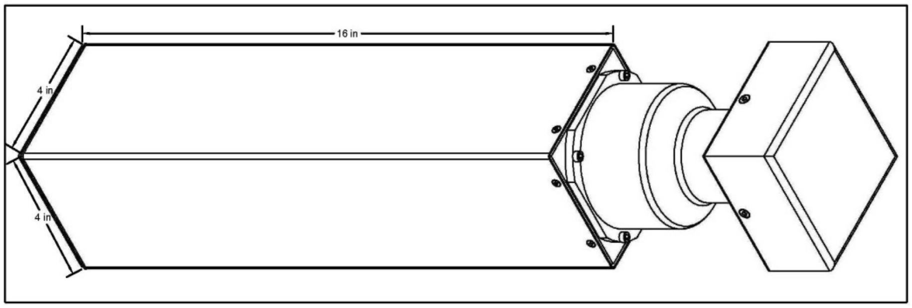


Figure 5. RSI-700 Detector Dimensions

The objective of this appendix is to calculate the scan sensitivity of the RS-700 NaI scintillation detection system utilized for gross gamma drive over and potentially wall surveys for ^{226}Ra LLROs.

2.2 SITE RADIOLOGICAL CONDITIONS

The Parcel F survey units to be surveyed consist of structures potentially contaminated with ^{226}Ra in small objects on the surface. Any ^{226}Ra present is assumed to be in secular equilibrium with decay products with half-lives less than 6 months.

2.3 DESCRIPTION OF RS-700 SYSTEM

Surface scanning at the site was performed using the RSI-700 mobile radiation detection system. The RSI-700 consists of an RSI-701 gamma ray spectrometer (MCA)/controller equipped with two RSX-1 4-liter (256 cubic inch) NaI gamma scintillation detectors. The detector dimensions are 4-inch by 4 inch by 16-inch long. The RSI-700 system is designed to measure and record radiation measurements from a moving platform and incorporates a GPS receiver such that detector position is integrally stored with the radiological information.

Surveys will be performed by traveling along the path of a survey area in rows equal to the width of the RS-700 FOV. The coverage goal is 100 percent for Class 3 survey units.

For drive over surveys the tow vehicle will be driven at a target speed of 1.0 meter per second (m/sec) or slower. At this speed, the residence time of the detector over a small area of elevated contamination will be 0.5 second. The system is operated using RSI's 'RadAssist" software, which shows real-time data collection, both as a NaI spectra as well as the count rates, in units of counts per second (cps), from the programmed ROIs. If used in the wall scan orientation, the scan speed for the RS-700 will be 0.5 m/sec or slower.

2.4 SCAN MDA FOR LLRO - CALCULATION AND METHODOLOGY

The methodology used to determine the NaI scintillation detector scan MDA was based on NUREG-1507, Section 6.8.2. Factors included in this analysis were the surveyor scan efficiency, index of sensitivity, the natural background of the surveyed area, scan rate, detector to source geometry, and energy and yield of gamma emissions.

Microshield® was used to model the presence of a deck marker containing 5 microcuries of ^{226}Ra on a concrete surface. The active area of the disk was assumed to be 7/8-inch diameter, covered with a 3/8-inch thick plastic cover. The deck marker was assumed to be located directly between the two detectors, 6 inches from the end of the detector, and assumed to be the worst-case positioning of the deck marker. The detector was suspended 10 cm (4 inches) above the surface being scanned. The uncontaminated soil cover thickness was assumed to have zero thickness (the deck marker was located on the surface). There was a 0.051 cm aluminum shield surrounded by approximately 0.125 inches of carbon fiber and 1.25 inches of rigid foam, "Poron" foam and felt wrap surrounding the NaI detectors. The carbon shield was assumed to be 0.5 cm to account for the rigid, "poron", and felt layers. The thin aluminum wrapper was also considered as part of the 0.5 cm of carbon to complete the model source term. The assumed density of soil is 1.6 grams per cubic centimeter (g/cm^3). This model is consistent with the NUREG-1507 methodology and provides for a count rate to exposure rate ratio (counts per minute/microroentgen per hour [cpm/μR/hr]) to be calculated.

The following sections provide tabulated data based upon the NUREG-1507 methodology as applied toward the RX-700 NaI scintillation detectors used in this survey. The dose point is located 6 inches from the deck marker source (the worst-case geometry).

2.4.1 Fluence Rate to Exposure Rate (FRER, no units)

The fluence rate to exposure rate (FRER) may be approximated by:

$$\text{FRER} \sim (1\ \mu\text{R/hr})/(E_\gamma)(\mu_{en}/\rho)_{air}$$

Where,

E_γ = energy of the gamma photon of concern, kiloelectron volts (keV)

$(\mu_{en}/\rho)_{air}$ = the mass energy absorption coefficient for air, square centimeters per gram (cm^2/g)

The FRER is shown in tabular form in Table 2.

Table 2. Fluence Rate to Exposure Rate Conversion

$Energy_{\gamma}$, keV	$(\mu_{en}/\rho)_{air}$, cm^2/g	FRER
15	1.334	0.0500
20	0.5389	0.0928
30	0.1537	0.2169
40	0.06833	0.3659
50	0.04098	0.4880
60	0.03041	0.5481
80	0.02407	0.5193
100	0.02325	0.4301
150	0.02496	0.2671
200	0.02672	0.1871
300	0.02872	0.1161
400	0.02949	0.0848
500	0.02966	0.0674
600	0.02953	0.0564
662	0.0293	0.0516
800	0.02882	0.0434
1,000	0.02789	0.0359
1,500	0.02547	0.0262
2,000	0.02345	0.0213

2.4.2 Probability of Interaction (P) Through Detector End for a Given Energy

The probability, P, of a gamma ray interaction in the NaI scintillation crystal entering through the end of the crystal is given by:

$$\text{Probability (P)} = 1\text{-}e^{-(\mu/\rho)_{NaI}(X)(\rho_{NaI})}$$

Where

$(\mu/\rho)_{NaI}$ = the mass attenuation coefficient for NaI

X = the thickness through the bottom edge (end facing soil) of the RX-700 NaI crystal, 10.16 cm

ρ = the density of the NaI crystal, 3.67 g/cm^3

Values for P are listed in Table 3.

Table 3. Probability of Interaction

Energy$_\gamma$, keV	$(\mu/\rho)_{NaI}$, cm^2/g	P
15	47.4	1.00
20	22.3	1.00
30	7.45	1.00
40	19.3	1.00
50	10.7	1.00
60	6.62	1.00
80	3.12	1.00
100	1.72	1.00
150	0.625	1.00
200	0.334	1.00
300	0.167	1.00
400	0.117	0.99
500	0.0955	0.97
600	0.0826	0.95
662	0.078	0.95
800	0.0676	0.92
1,000	0.0586	0.89
1,500	0.0469	0.83
2,000	0.0413	0.79

2.4.3 Relative Detector Response

The Relative Detector Response (RDR) by energy is determined by multiplying the relative fluence rate to exposure rate (FRER) by the probability (P) of an interaction and is given by:

RDR = FRER (Table 2) x P (from Table 3)

Values for RDR are listed in Table 4.

Table 4. Relative Detector Response

Energy$_\gamma$, keV	FRER	P	RDR
15	0.0500	1.00	0.0500
20	0.0928	1.00	0.0928
30	0.2169	1.00	0.2169
40	0.3659	1.00	0.3659
50	0.4880	1.00	0.4880
60	0.5481	1.00	0.5481
80	0.5193	1.00	0.5193
100	0.4301	1.00	0.4301
150	0.2671	1.00	0.2671
200	0.1871	1.00	0.1871
300	0.1161	1.00	0.1158
400	0.0848	0.99	0.0837
500	0.0674	0.97	0.0655
600	0.0564	0.95	0.0538
662	0.0516	0.95	0.0487
800	0.0434	0.92	0.0399
1,000	0.0359	0.89	0.0318
1,500	0.0262	0.83	0.0216
2,000	0.0213	0.79	0.0168

2.4.4 Determination of cpm per μR/hr as a Function of Energy

The FRER, P, and RDR were calculated at the energies provided above for a NaI Scintillation detector. Calculation of these values specifically at the cesium-137 (^{137}Cs) energy of 662 keV has also been performed by the Microshield® software. This point allows one to determine the cpm per μR/hr and ultimately activity concentration and minimum detection sensitivity level in terms of pCi/g.

If:

- the fluence rate to exposure rate conversion is 0.0514, and
- the energy$_\gamma$ (based upon ^{137}Cs) is 662 keV, and
- the air density is 0.0294 cm^2/g, and
- the mass attenuation coefficient of the the RSI-700 NaI crystal is 0.078 cm^2/g, and
- the ^{137}Cs relative detector response is 0.0486

Then the detector response (cpm) to other energies (such as ^{226}Ra and daughters) was based upon the ratio of the RDR at energy (E_i) to the known ^{137}Cs energy RDR demonstrated as:

$$(cpm/\mu R/hr)_{E_i} = (cpm_{Cs-137}) * ((RDR_{Ei})/(RDR_{Cs-137}))$$

Which equals 20,770 cpm * ((RDR_{Ei})/($RDR_{Cs\text{-}137}$)). This is shown in tabular form in Table 5.

Table 5. Detector Response

Energy$_\gamma$, keV	**RDR_{Ei}**	**RSI-700 4-Liter NaI Detector, E_i, cpm per µR/hr**
15	0.0500	21295
20	0.0928	39536
30	0.2169	92413
40	0.3659	155904
50	0.4880	207964
60	0.5481	233540
80	0.5193	221291
100	0.4301	183276
150	0.2671	113813
200	0.1871	79737
300	0.1158	49359
400	0.0837	35663
500	0.0655	27917
600	0.0538	22945
662	0.0487	20770
800	0.0399	16996
1,000	0.0318	13560
1,500	0.0216	9213
2,000	0.0168	7138

Finally, the count rate to exposure rate ratio for each of the ^{226}Ra and progeny gamma emissions and their contribution to the total exposure rate was computed using the output of the Microshield® runs and the count rate to exposure rate ratios from Table 5. Table 6 provides the counts from each of the calculated observations intervals. Figure 6 provides a copy of the Microshield® output for the RS-700.

Table 6. Detector Weighted Response

keV	MicroShield® Exposure Rate, µR/hr (with buildup)	cpm/µR/hr	cpm/µR/hr (weighted)	Percent of NaI detector response
15	1,441	21,295	3.07E+07	0.99%
20	0.0	39,536	0.00E+00	0.00%
30	0.0	92,413	0.00E+00	0.00%
40	0.0	155,904	0.00E+00	0.00%
50	557.0	207,964	1.16E+08	3.73%
60	0.0	233,540	0.00E+00	0.00%
80	2,586	221,291	5.72E+08	18.44%
100	1.592	183,276	2.92E+05	0.01%
150	0.0	113,813	0.00E+00	0.00%
200	2,012	79,737	1.60E+08	5.17%
300	5,602	49,359	2.77E+08	8.91%
400	13,610	35,663	4.85E+08	15.64%
500	782.8	27,917	2.19E+07	0.70%
600	24,920	22,945	5.72E+08	18.42%
800	6,119	16,996	1.04E+08	3.35%
1000	24,350	13,560	3.30E+08	10.64%
1500	20,200	9,213	1.86E+08	6.00%
2000	34,820	7,138	2.49E+08	8.01%
Total	137,000		3,103,860,848	100%

The minimum detectable count rate, MDCR, was calculated as:

$$MDCR = (d') \text{ x } (b_i)^{0.5} \text{ x } (60 \text{ sec}/1 \text{ min})$$

Where d’ is equal to 1.38 from table 6.1 of NUREG-1507, and represents the rate of detections at a 95 percent true positive proportion with a false positive proportion of 60 percent. Table 7 lists potential values for b and the (1 min) denominator for the different scan speeds, and was based on the estimated reference area background count rate of 2,527 cps. The MDCR values for different scan speeds are listed in Table 7.

MicroShield 10.00 Cabrera Services		
Date	By	Checked

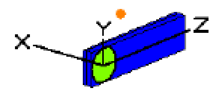
File Name	Run Date	Run Time	Duration
20171129_MSCASE_Ra226Marker_5uCi_Intact_CLASSwOffset.msd	November 29, 2017	17:16:59	00:00:00

Project Info	
Case Title	20171129_Case 1
Description	CLASS 5uCi Ra226 Intact Marker 10cm with 15cm offset
	3 - Disk

Source Dimensions	
Radius	2.22 cm (0.9 in)

Dose Points			
A	X	Y	Z
#1	10.0 cm (3.9 in)	0.0 cm (0 in)	15.0 cm (5.9 in)

Shield			
Shield N	Dimension	Material	Density
Shield 1	.953 cm	Methyl methacrylate	0.943
Shield 2	.5 cm	Carbon	2.25
Air Gap		Air	0.00122



Source Input: Grouping Method - Standard Indices
Number of Groups: 25
Lower Energy Cutoff: 0.015
Photons< 0.015: Included
Library: Grove

Nuclide	Ci	Bq	μCi/cm²	Bq/cm²
Bi-210	3.8904e-006	1.4395e+005	2.5127e-001	9.2970e+003
Bi-214	4.8919e-006	1.8100e+005	3.1595e-001	1.1690e+004
Pb-210	3.8910e-006	1.4397e+005	2.5131e-001	9.2985e+003
Pb-214	4.8919e-006	1.8100e+005	3.1595e-001	1.1690e+004
Po-210	3.8731e-006	1.4330e+005	2.5015e-001	9.2556e+003
Po-214	4.8909e-006	1.8096e+005	3.1589e-001	1.1688e+004
Po-218	4.8929e-006	1.8104e+005	3.1602e-001	1.1693e+004
Ra-226	4.8929e-006	1.8104e+005	3.1601e-001	1.1693e+004
Rn-222	4.8929e-006	1.8104e+005	3.1602e-001	1.1693e+004

Buildup: The material reference is Shield 2
Integration Parameters

Radial	20
Circumferential	20

Results

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup	Absorbed Dose Rate mrad/hr No Buildup	Absorbed Dose Rate mrad/hr With Buildup	Absorbed Dose Rate mGy/hr No Buildup	Absorbed Dose Rate mGy/hr With Buildup
0.015	6.186e+04	9.346e-03	1.680e-02	8.016e-04	1.441e-03	6.998e-04	1.258e-03	6.998e-06	1.258e-05
0.05	7.832e+03	4.840e-02	2.091e-01	1.289e-04	5.570e-04	1.126e-04	4.863e-04	1.126e-06	4.863e-06
0.08	4.173e+04	4.506e-01	1.634e+00	7.130e-04	2.586e-03	6.225e-04	2.258e-03	6.225e-06	2.258e-05
0.1	2.457e+02	3.428e-03	1.040e-02	5.244e-06	1.592e-05	4.578e-06	1.390e-05	4.578e-08	1.390e-07
0.2	1.950e+04	6.028e-01	1.140e+00	1.064e-03	2.012e-03	9.288e-04	1.756e-03	9.288e-06	1.756e-05
0.3	3.735e+04	1.840e+00	2.953e+00	3.491e-03	5.602e-03	3.048e-03	4.890e-03	3.048e-05	4.890e-05
0.4	6.926e+04	4.744e+00	6.985e+00	9.244e-03	1.361e-02	8.070e-03	1.188e-02	8.070e-05	1.188e-04
0.5	3.233e+03	2.857e-01	3.988e-01	5.607e-04	7.828e-04	4.895e-04	6.834e-04	4.895e-06	6.834e-06
0.6	8.727e+04	9.483e+00	1.277e+01	1.851e-02	2.492e-02	1.616e-02	2.176e-02	1.616e-04	2.176e-04
0.8	1.711e+04	2.572e+00	3.217e+00	4.891e-03	6.119e-03	4.270e-03	5.342e-03	4.270e-05	5.342e-05
1.0	5.667e+04	1.094e+01	1.321e+01	2.017e-02	2.435e-02	1.761e-02	2.126e-02	1.761e-04	2.126e-04
1.5	3.446e+04	1.044e+01	1.201e+01	1.756e-02	2.020e-02	1.533e-02	1.763e-02	1.533e-04	1.763e-04
2.0	4.844e+04	2.011e+01	2.252e+01	3.110e-02	3.482e-02	2.715e-02	3.040e-02	2.715e-04	3.040e-04
Total	**4.850e+05**	**6.154e+01**	**7.707e+01**	**1.082e-01**	**1.370e-01**	**9.450e-02**	**1.196e-01**	**9.450e-04**	**1.196e-03**

Figure 6. Microshield® Output for 5 μCi ^{226}Ra Deck Marker Using RS-700

The Minimum Detectable Count Rate for the surveyor is calculated as:

$$MDCR_{surveyor} = MDCR/(p)^{0.5}$$

Where

p = Surveyor Efficiency, equal to 0.7 (NUREG-1507 suggests values between 0.5 and 0.75)

Table 7 provides the $MDCR_{surveyor}$ for different scan speeds.

The Minimum Detectable Exposure Rate for the surveyor was obtained from the $MDCR_{surveyor}$ divided by the weighted count rate to exposure rate value of 3,103,860,848 cpm/µR/hr for radium and its progeny. Table 7 provides the $MDER_{surveyor}$ for different scan speeds.

The scan MDC was equal to the ratio of the $MDER_{surveyor}$ to the total weighted MicroShield® Exposure Rate from Table 6 for a deck marker containing 5 µCi of ^{226}Ra. The MDC values for the different scan speeds are listed in Table 7.

Table 7. Minimum Detectable Concentration

Scan Speed (m/s)	Observation Interval (sec)	Counts (b_i)	MDCR (cpm)	$MDCR_{surveyor}$ (cpm)	$MDER_{surveyor}$ (µR/hr)	MDC (pCi)
0.5	1.0	2,527	4,162	4,975	1.60E-06	1.17E-11
1.0	0.5	1,263	5,885	7,034	2.27E-06	1.65E-11
2.0	0.25	632	8,326	9,952	3.21E-06	2.34E-11
3.0	0.167	421	10,193	12,184	3.93E-06	2.87E-11
4.0	0.125	316	11,775	14,074	4.53E-06	3.31E-11

2.5 CONCLUSION

The RS-700 NaI scintillation scan MDA, for ^{226}Ra in secular equilibrium with progeny, for an intact deck marker containing 5 microcuries of ^{226}Ra, was estimated to be less than 3.0×10^{-11} pCi (less than 1.0 etacurie per gram) for scan speeds less than 3.0 m/s. The values computed are indicative of a sensitive instrument that agrees with scan MDA data presented in NUREG-1507 Section 6.8.2 and MARSSIM Table 6.7 for the contaminants of concern. However, these scan MDA values are less than the ^{226}Ra concentration in concrete, and less than the variability in the ^{226}Ra concentration in concrete, so the calculated scan MDA value cannot be practically achieved.

An intact deck marker containing 5 microcuries of ^{226}Ra can be detected by the RS-700 at any reasonable scan speed. For the purposes of this project, scan speeds for the RS-700 will be maintained at 1 m/s or less.

3.0 3-INCH BY 3-INCH NAI ^{226}RA SCAN MINIMUM DETECTABLE ACTIVITY

Hand-held 3-inch by 3-inch NaI detectors were used to scan for elevated concentrations of ^{226}Ra. The assumptions, methodology, and calculation of the detector response for ^{226}Ra for the 3-inch by 3-inch NaI for anticipated conditions and situations are described in this section. For this calculation, the detector is assumed to be 15 cm (6 inches) above the center of the source. The source was assumed to be an intact deck marker containing 5 microcuries of ^{226}Ra. The active area of the deck marker was assumed to be 7/8-inch dimeter, covered with a 3/8-inch plastic cover. The calculations and methodologies used to determine the MDC follow the guidance contained in NUREG-1507, Section 6.8.2 (USNRC, 1997). This is the same methodology and same size area of elevated activity used to determine the scan MDA for the RS-700 in Section 2 of this appendix.

Table 8 lists the FRER.

Table 9 lists the probability of interaction with the detector.

Table 10 lists the relative detector response.

Table 11 lists the detector response to ^{226}Ra based on a response to ^{137}Cs of 2,700 cpm/μR/hr.

Table 12 lists the weighted detector response.

Table 8. FRER for 3x3 NaI(Tl)

Energy$_\gamma$, keV	$(\mu_{en}/\rho)_{air}$, cm^2/g	FRER
15	1.29	0.0517
20	0.516	0.0969
30	0.147	0.2268
40	0.064	0.3906
50	0.0384	0.5208
60	0.0292	0.5708
80	0.0236	0.5297
100	0.0231	0.4329
150	0.0251	0.2656
200	0.0268	0.1866
300	0.0288	0.1157
400	0.0296	0.0845
500	0.0297	0.0673
600	0.0296	0.0563
800	0.0289	0.0433
1,000	0.0280	0.0357
1,500	0.0255	0.0261
2,000	0.0234	0.0214

Table 9. Probability of Interaction for the 3x3 NaI(Tl) Detector

$Energy_{\gamma}$, keV	$(\mu_{en}/\rho)_{NaI}$, cm^2/g	P
15	47.4	1.00
20	22.3	1.00
30	7.45	1.00
40	19.3	1.00
50	10.7	1.00
60	6.62	1.00
80	3.12	1.00
100	1.72	1.00
150	0.625	1.00
200	0.334	1.00
300	0.167	0.99
400	0.117	0.96
500	0.0955	0.93
600	0.0826	0.90
800	0.0676	0.85
1,000	0.0586	0.80
1,500	0.0469	0.73
2,000	0.0413	0.68

Table 10. Relative Detector Response

Energy$_\gamma$, keV	FRER	P	RDR
15	0.0517	1.00	0.0517
20	0.0969	1.00	0.0969
30	0.2268	1.00	0.2268
40	0.3906	1.00	0.3906
50	0.5208	1.00	0.5208
60	0.5708	1.00	0.5708
80	0.5297	1.00	0.5297
100	0.4329	1.00	0.4329
150	0.2656	1.00	0.2656
200	0.1866	1.00	0.1866
300	0.1157	0.99	0.1146
400	0.0845	0.96	0.0812
500	0.0673	0.93	0.0626
600	0.0563	0.90	0.0507
800	0.0433	0.85	0.0367
1,000	0.0357	0.80	0.0287
1,500	0.0261	0.73	0.0191
2,000	0.0214	0.68	0.0146

Table 11. 3x3 NaI(Tl) Detector Response

$Energy_{\gamma}$, keV	RDR_{Ei}	Ludlum 44-20 3x3 NaI Detector, E_i, cpm per μ/hr
15	0.0517	3064
20	0.0969	5745
30	0.2268	13445
40	0.3906	23161
50	0.5208	30881
60	0.5708	33842
80	0.5297	31404
100	0.4329	25667
150	0.2656	15748
200	0.1866	11061
300	0.1146	6797
400	0.0812	4816
500	0.0626	3714
600	0.0507	3005
662	0.0455	2700
800	0.0367	2175
1,000	0.0287	1704
1,500	0.0191	1131
2,000	0.0146	867

Table 12. 3x3 NaI(Tl) Weighted Detector Response

keV	MicroShield® Exposure Rate, µR/hr (with buildup)	cpm/µR/hr	cpm/µR/hr (weighted)	Percent of NaI detector response
15	5,773	3064	1.77E+07	3.24%
20	0.0	5745	0.00E+00	0.00%
30	0.0	13445	0.00E+00	0.00%
40	0.0	23161	0.00E+00	0.00%
50	487.3	30881	1.50E+07	2.75%
60	0.0	33842	0.00E+00	0.00%
80	2,291	31404	7.19E+07	13.17%
100	1.556	25667	3.99E+04	0.01%
150	0.0	15748	0.00E+00	0.00%
200	2,525	11061	2.79E+07	5.11%
300	7,585	6797	5.16E+07	9.44%
400	19,010	4816	9.16E+07	16.76%
500	1110	3714	4.12E+06	0.75%
600	35,630	3005	1.07E+08	19.60%
800	8,987	2175	1.95E+07	3.58%
1000	35,990	1704	6.13E+07	11.22%
1500	29,920	1131	3.38E+07	6.19%
2000	51,560	867	4.47E+07	8.18%
Total	200,870		546,366,130	100.00%

Figure 7 provides a copy of the Microshield® output for the 3-inch by 3-inch NaI(Tl) detector.

MicroShield 10.00
Cabrera Services

Date	By	Checked

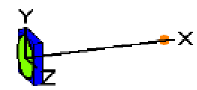
File Name	Run Date	Run Time	Duration
20171129_MSCASE_Ra226Marker_5uCi_Intact_3x3.msd	November 29, 2017	17:50:45	00:00:00

Project Info	
Case Title	20171129_Case 3
Description	3x3 NaI 5uCi Ra226 Intact Marker 15cm with 0cm offset
	3 - Disk

Source Dimensions	
Radius	2.22 cm (0.9 in)

Dose Points			
A	X	Y	Z
#1	15.0 cm (5.9 in)	0.0 cm (0 in)	0.0 cm (0 in)

Shield N	Dimension	Material	Density
Shield 1	.953 cm	Methyl methacrylate	0.943
Shield 2	.05 cm	Aluminum	2.7
Air Gap		Air	0.00122



Source Input: Grouping Method - Standard Indices
Number of Groups: 25
Lower Energy Cutoff: 0.015
Photons< 0.015: Included
Library: Grove

Nuclide	Ci	Bq	µCi/cm²	Bq/cm²
Bi-210	3.8904e-006	1.4395e+005	2.5127e-001	9.2970e+003
Bi-214	4.8919e-006	1.8100e+005	3.1595e-001	1.1690e+004
Pb-210	3.8910e-006	1.4397e+005	2.5131e-001	9.2985e+003
Pb-214	4.8919e-006	1.8100e+005	3.1595e-001	1.1690e+004
Po-210	3.8731e-006	1.4330e+005	2.5015e-001	9.2556e+003
Po-214	4.8909e-006	1.8096e+005	3.1589e-001	1.1688e+004
Po-218	4.8929e-006	1.8104e+005	3.1602e-001	1.1693e+004
Ra-226	4.8929e-006	1.8104e+005	3.1601e-001	1.1693e+004
Rn-222	4.8929e-006	1.8104e+005	3.1602e-001	1.1693e+004

Buildup: The material reference is Shield 1
Integration Parameters

Radial	20
Circumferential	20

Results

Energy (MeV)	Activity (Photons/sec)	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup	Absorbed Dose Rate mrad/hr No Buildup	Absorbed Dose Rate mrad/hr With Buildup	Absorbed Dose Rate mGy/hr No Buildup	Absorbed Dose Rate mGy/hr With Buildup
0.015	6.186e+04	4.381e-02	6.731e-02	3.757e-03	5.773e-03	3.280e-03	5.040e-03	3.280e-05	5.040e-05
0.05	7.832e+03	1.091e-01	1.829e-01	2.905e-04	4.873e-04	2.536e-04	4.255e-04	2.536e-06	4.255e-06
0.08	4.173e+04	9.726e-01	1.448e+00	1.539e-03	2.291e-03	1.344e-03	2.000e-03	1.344e-05	2.000e-05
0.1	2.457e+02	7.249e-03	1.017e-02	1.109e-05	1.556e-05	9.681e-06	1.358e-05	9.681e-08	1.358e-07
0.2	1.950e+04	1.189e+00	1.430e+00	2.098e-03	2.525e-03	1.832e-03	2.204e-03	1.832e-05	2.204e-05
0.3	3.735e+04	3.479e+00	3.998e+00	6.599e-03	7.585e-03	5.761e-03	6.621e-03	5.761e-05	6.621e-05
0.4	6.926e+04	8.709e+00	9.757e+00	1.697e-02	1.901e-02	1.481e-02	1.660e-02	1.481e-04	1.660e-04
0.5	3.233e+03	5.129e-01	5.656e-01	1.007e-03	1.110e-03	8.790e-04	9.691e-04	8.790e-06	9.691e-06
0.6	8.727e+04	1.674e+01	1.825e+01	3.267e-02	3.563e-02	2.852e-02	3.110e-02	2.852e-04	3.110e-04
0.8	1.711e+04	4.422e+00	4.725e+00	8.411e-03	8.987e-03	7.343e-03	7.846e-03	7.343e-05	7.846e-05
1.0	5.667e+04	1.846e+01	1.952e+01	3.403e-02	3.599e-02	2.971e-02	3.142e-02	2.971e-04	3.142e-04
1.5	3.446e+04	1.706e+01	1.778e+01	2.871e-02	2.992e-02	2.506e-02	2.612e-02	2.506e-04	2.612e-04
2.0	4.844e+04	3.225e+01	3.334e+01	4.986e-02	5.156e-02	4.353e-02	4.501e-02	4.353e-04	4.501e-04
Total	**4.850e+05**	**1.040e+02**	**1.111e+02**	**1.860e-01**	**2.009e-01**	**1.623e-01**	**1.754e-01**	**1.623e-03**	**1.754e-03**

Figure 7. Microshield® Output for 5 µCi ^{226}Ra Deck Marker Using a 3-inch by 3-inch NaI(Tl) Detector

The minimum detectable count rate, MDCR, was calculated as:

$$MDCR = (d') \times (b_i)^{0.5} \times (60 \text{ sec}/1 \text{ min})$$

Where d' is equal to 1.38 from Table 6.1 of NUREG-1507, and represents the rate of detections at a 95 percent true positive proportion with a false positive proportion of 60 percent.

At a scan speed of 0.5 m/s with an observation interval of 1 second and an estimated reference area count rate of 15,000 cpm for the 3-inch by 3-inch NaI(Tl) detector, the MDCR is 1.309 cpm.

The Minimum Detectable Count Rate for the surveyor was calculated as:

$$MDCR_{surveyor} = MDCR/(p)^{0.5} = 1{,}565 \text{ cpm}$$

Where

p = Surveyor Efficiency, equal to 0.7 (NUREG-1507 suggests values between 0.5 and 0.75)

The $MDER_{surveyor}$ is obtained from the $MDCR_{surveyor}$ divided by the weighted count rate to exposure rate value of 546,366,130 cpm/μR/hr for radium and its progeny, and equals 2.86 x 10^{-6} μR/hr.

The scan MDA is equal to the ratio of the $MDER_{surveyor}$ to the total weighted MicroShield® Exposure Rate from Table 6 for a deck marker containing 5 μCi of ^{226}Ra. The ^{226}Ra scan MDA using a 3-inch by 3-inch NaI(Tl) detector is 2.09 x 10^{-11} pCi/g for the described project conditions and parameters. Similar to the RS-700 the scan speed calculated for the 3-inch by 3-inch NaI(Tl) detector is less than the variability in background and cannot be practically achieved. The calculation does demonstrate the deck marker can be readily identified at the recommended scan speed of 0.5 m/s.

4.0 Deck Markers Containing ^{90}Sr

The scan MDA for deck markers containing ^{90}Sr cannot be calculated using the approach described in MARSSIM and NUREG-1507 for gamma-emitting radionuclides, because ^{90}Sr does not emit any photons to detect using the RS-700. In addition, the ^{90}Sr deck markers are typically covered with 3/8-inch plastic covers preventing the identification of ^{90}Sr based on beta emissions. However, beta particles emitted by ^{90}Sr interact with surrounding materials to release bremsstrahlung radiation. Based on photon spectra collected from recovered deck markers containing ^{90}Sr, the bremsstrahlung radiation has energies from 50 to 250 keV with a peak centered around 80 keV (Figure 8).

The 80 keV peak appears to be at least four times the background for photons with energies around 80 keV. The increased count rate from the ^{90}Sr bremsstrahlung radiation in a window centered around 80 keV would be detectable using the equations from MARSSIM Section 6.7.2.1. An average count of 4,400 counts per keV in 300 seconds was assumed for a ^{90}Sr deck marker from 65 keV to 95 keV, with an expected background of 1,000 counts per keV for the same energy range. This results in 2,640 cpm for the ^{90}Sr deck marker with a background of 500 cpm.

The minimum detectable count rate, MDCR, was calculated as:

$$MDCR = (d') \times (b_i)^{0.5} \times (60 \text{ sec}/1 \text{ min})$$

Where d' is equal to 1.38 from MARSSIM Table 6.5, and represents the rate of detections at a 95 percent true positive proportion with a false positive proportion of 60 percent. Table 13 lists potential values for b for different scan speeds with different observation intervals, and was based on the assumed background count rate of 500 cpm for energies between 65 and 95 keV. The MDCR values for different scan speeds are listed in Table 13. All of the MDCR values are less than the count rate of 2,640 cpm estimated for ^{90}Sr bremsstrahlung radiation. At scan rates less than 2 m/s, the RS-700 will detect deck markers containing ^{90}Sr.

Table 13. Minimum Detectable Count Rate

Scan Speed (m/s)	Observation Interval (sec)	Counts (b_i)	MDCR (cpm)
0.5	1.0	8.33	239.02
1.0	0.5	4.17	338.03
2.0	0.25	2.08	478.05
3.0	0.167	1.39	585.48
4.0	0.125	1.04	676.06

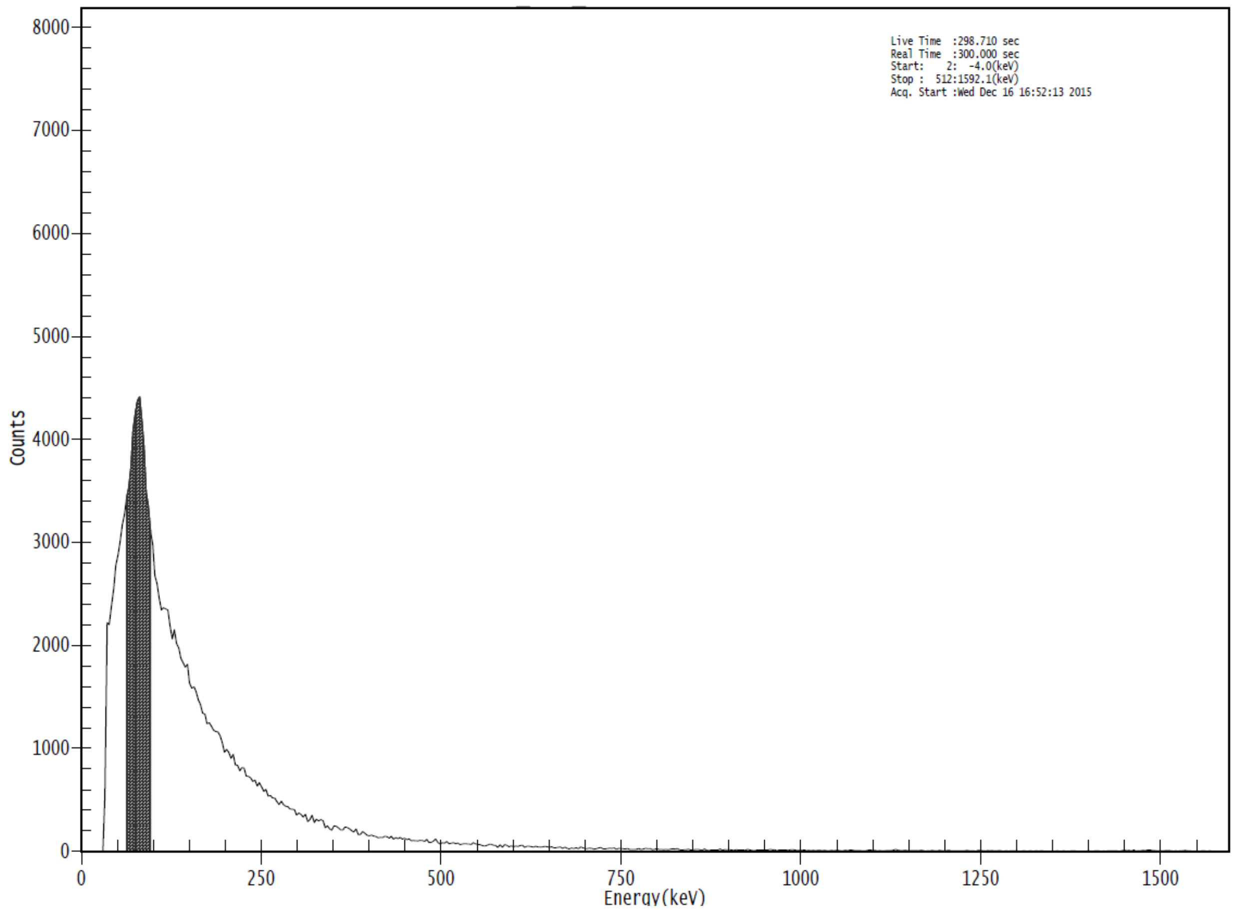


Figure 8. Example Photon Spectrum for Deck Marker Containing ^{90}Sr

Appendix E
Responses to Comments

<table>
<tr><th colspan="2">Response to Comments on the Draft Radiological Characterization Surveys Work Plan, Parcel F Structures, Hunters Point Naval Shipyard, San Francisco, California, February 2018, DCN: APTM-0006-4550-0014</th></tr>
<tr><td colspan="2">Comments by: Dr. Sheetal Singh, Senior Health Physicist, California Department of Public Health, Environmental Management Branch, comments dated May 15, 2018; comments received May 16, 2018</td></tr>
<tr><th>General Comments</th><th>Response</th></tr>
<tr><td>1. The California Department of Public Health - Environmental Management Branch (CDPH-EMB) utilizes the California Code of Regulations (CCR), Title 17, Section 30256(k), which requires:
a. Radioactive material be properly disposed;
b. A reasonable effort has been made to eliminate residual radioactive contamination;
c. A radiation survey has been performed which demonstrates that the premises are suitable for release for unrestricted use.

In practice this means employing the process outlined in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM, NRC et al, 1997), which includes establishing a reference background area for each of the materials to remain in situ. These reference background measurements are then compared to survey units (SUs).</td><td>a. Work Plan Section 4.6, Waste Management Plan, was revised as follows:
"A WMP was prepared to allow for proper storage, characterization, and disposal of liquid and solid waste generated during the field activities. This plan addresses management, anticipated stockpiling, handling/transportation, and disposal of the non-radioactive waste streams derived during the fieldwork. The WMP is included as Appendix C. <u>APTIM will not dispose of radioactive waste. Radioactive material, if any, that is identified during field activities will be collected, segregated, and stored in appropriate containers per the RPP (APTIM, 2017b) for subsequent packaging and disposal by a certified waste broker under the direction of the Navy LLRW Disposal Program</u>."
b. The survey areas have been classified as Class 3 area with little or no potential for residual radioactivity. Work Plan Section 7.5, Waste Management, states "Any investigation derived waste will be managed in accordance with the WMP (Appendix C)."
c. Work Plan Section 9.0, Reporting Requirements, describes how the results of surveys implemented using this Work Plan will be documented.
As stated in Work Plan Section 5.3.1 "The reference area behind Building 810 (Figure 1) will be used to establish gamma instrument-specific investigation levels (ILs). Reference data will be collected in similar matrix (i.e., concrete pad, wood, metals). If needed, additional reference areas may be established with the approval of the Navy."</td></tr>
<tr><td>2. Please perform the following statistical analyses on the data collected from the SUs with data collected from the background reference area: box plot, histogram, distribution analysis, normal probability plot, and comparison to background reference area.</td><td>No background data has been collected prior to the field work. The investigation level (IL) will be established based on the background data as described in Work Plan Section 5.3.1.
The following bullet was added to Work Plan Section 9.0, Reporting Requirements:
• "<u>Data evaluation results including data conversion, summary statistics, graphical data review (e.g., histograms, normal</u></td></tr>
</table>

	probability plots), and comparison to background reference area data."
3. Please provide explanation why soil background measurements are being used for potential investigation levels (IL) rather than material representative of that being sampled (i.e. concrete, wood, etc.).	It is not anticipated that concrete samples will be collected during this work effort. Additional reference samples (i.e., concrete) will be established, if needed, with the approval of the Navy. Reference area data and investigation levels (ILs) will be provided to the radiological control technicians (RCTs) prior to the start of a survey for their use during data collection.
4. Gamma Walk-over survey/Drive-over survey (GWS/GDS) data should be cross- hatched to ensure that no GDS data gaps exist larger than the detector area and no GWS data gaps exist larger than 1 meter, without acceptable explanation (i.e. physical obstructions, water, etc.)	Survey coverage will be determined by the detector field of view and the path that the detector takes, based upon global positioning system (GPS). The survey coverage will be compared against the survey data quality objective (DQO) identified in the Work Plan. If insufficient survey data coverage exists, the field team will return to the area to collect additional data. Inaccessible areas (i.e. physical obstructions) will be noted in the field documentation. Cross-hatching gamma walkover survey (GWS) and gamma drive-over survey (GDS) data will not be necessary if the coverage obtained is greater than or equal to the survey coverage DQO.
Specific Comments	**Response**
5. Section 1.0 ("Introduction"). Page 1-2: a. "The Objective of this Work Plan is to describe radiological characterization surveys designed to provide results with sufficient quantity and quality to meet requirements for a final status survey and achieve unrestricted release for Parcel F structures". EMB noted the work plan is a characterization survey plan, in addition, will a Final Status Survey report be provided to review? **b.** Page 1-2, Section 1.0, Introduction, Please justify and describe how the characterization surveys are designed to provide results with sufficient quantity and quality to meet requirements for a final status survey?	a. As described in Work Plan Section 5.4, the data quality objectives lay out the details for the characterization surveys to support the final status survey (FSS). The objective of the radiological characterization surveys is to characterize and remove potential residual radioactivity of the Parcel F structures. The surveys are designed to support unrestricted release if no contamination is identified. As stated in Section 9.0, if no contamination is identified a FSS report will be prepared to document the results of the survey. b. For survey design purposes, the Parcel F structures are classified as Class 3 areas in a *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM; NRC et al., 2000) framework. Class 3 areas are unrestricted in size and meet the following criteria: (1) impacted; (2) little or no potential for delivering a dose above the release criterion; and (3) little or no potential for small areas of elevated activity. This characterization survey has been designed such that if contamination is not found, the survey results can be

	presented as a FSS to achieve unrestricted release. In addition, if residual radioactivity is found during the radiological surveys at levels that would prevent unrestricted release of the site, then the Navy will be notified of the presence of residual radioactivity to determine the appropriate next steps for further investigation.
6. Section 2.3 ("Nature and Extent of Contamination"), Page 2-3: "Nature and Extent of Contamination", based on this section the HRA has identified that radiological operations were conducted on the dry docks/piers such as: traces of radioluminescent devices are present, decontamination using sandblast material and the storage of radiological waste supports a radiological impacted for Parcel F structures. Although the sections also state, "the probability of residual radioactivity from radioluminescent devices, contaminated ships and leaking waste packages is very low, the Parcel F structures are radiologically impacted. Include a section explaining why the Navy thinks there is a low potential for residual radioactivity?	The approach and rationale of the *Final Historical Radiological Assessment Volume II, History of the Use of General Radioactive Materials, 1939–2003, Hunters Point Shipyard, San Francisco, California* (HRA; Naval Sea Systems Command, 2004), document reviews, site designation, radionuclide identification, and evaluation of previous investigations conducted during the HRA concluded there is a low potential for residual radioactivity for Parcel F structures. Furthermore, Drydocks and ship berths were decontaminated and surveyed following maintenance and decontamination of radiologically impacted ships. Sandblast material was removed and disposed of as described in Section 6.4.1 of the HRA (Naval Sea Systems Command, 2004). After removal of the sand, the drydock floor was vigorously washed and the water pumped into the harbor. The drydocks were surveyed and met the criteria for release.
7. Section 3.3 ("Anticipated Waste Streams"), Page 3-2. bullet 4: This bullet discusses radiologically contaminated soil. Since the piers appear to be concrete and metal, please explain where the soil is expected to be found.	Contaminated soil is not expected to be found during the radiological surveys. However, Survey Unit 3 (Ship Berths 62 and 63) appears to have soil on the surface as shown on Photograph 1 of the Work Plan. There are also areas currently inaccessible that may contain soil or sediment requiring sampling and analysis.
8. Section 5.1 ("Classification and Survey Units"), Page 5-1: a. This section states Parcel F structures are classified as Class 3 areas. Please state why the Navy decided to classify the structures as class 3 since radiological operations were identified at this site according to the HRA and the Navy has classified previous ship berths and piers as Class 1? b. The section states objective of the radiological characterization surveys is to characterize potential residual radioactivity of the Parcel F structures. The surveys have been designed to support unrestricted release if no contamination is identified". CDPH has noted the surveys described in this work plan function as a characterization surveys to	a. The HRA states the contamination potential for Drydocks 5, 6, and 7 is unlikely, with contaminated media and potential migration pathways identified as "low" or "none" which is consistent with a Class 3 classification. HRA Section 8.3.7.2 states the potential for contamination of ship berths is likely, especially berths where Operation Crossroads decontamination occurred. Ship berths with the highest potential for residual radioactivity have been surveyed as Class 1 areas and little or no contamination was identified. The results of previous investigations in areas with the highest potential for

identify radiological impacted material and also support unrestricted release. Please state how the characterization surveys will support unrestricted release? **c.** Explain why the Navy did not select a pier or dry dock as reference area? Please also refer to comment #3.	residual radioactivity support classification of the remaining ship berths as Class 3. b. The surveys meet the requirements of a MARSSIM Class 3 final status survey as well as including additional characterization. Therefore, the results of the survey can support unrestricted release if no contamination is identified. c. No non-impacted piers or drydocks are available at HPNS to use as reference areas.
9. Section 5.3.1 ("Site wide Soil Background Area"), Page 5-1: Please explain why the Navy did not select a pier or dry dock as a reference area?	No non-impacted piers or drydocks are available at HPNS to use as reference areas.
10. Section 5.4.3 ("Step Three- Identify Inputs into the Decision"), Page 5-3. Bullets 1 and 2: Please add the word scanning to differentiate types of surveys. Example bullet one would begin by reading, "surface gamma scanning surveys... "	The text was revised as requested.
11. Section 5.4.5 ("Step Five- Develop a Decision Rule"), Page 5-3. Paragraph 2. Sentence 1: If elevated radioactivity is discovered above the IL, how will the Navy address it?	Work Plan Section 5.8 states "Any time a radioactive anomaly is confirmed during radiological surveys, the location will be marked or flagged and GPS/grid coordinates will be recorded." Investigations will be performed to confirm the elevated readings. Investigations will start with data review and proceed to additional measurements and possible sample collection and analysis if warranted to confirm the presence of residual radioactivity and characterize contamination.
12. Section 5.4.5 ("Step Five - Develop a Decision Rule"), Page 5-4, Bullet 1: "If a gamma scan survey result exceeds the IL, that location will be included in the surface area covered by the alpha/beta survey." Please specify which alpha/beta survey.	The text was revised as follows: • "The IL for gamma scan measurements is the average of gamma scan measurements for a similar material in an appropriate background area plus three standard deviations. If a gamma scan survey result exceeds the IL, that location will be included in the surface area covered by the alpha/beta <u>scanning</u> survey. The IL for gamma scan measurements will be determined separately for the RS-700 and gamma scintillator handheld radiation detection instruments."

Response to Comments on the *Draft Radiological Characterization Surveys Work Plan, Parcel F Structures, Hunters Point Naval Shipyard, San Francisco, California,* February 2018, DCN: APTM-0006-4550-0014	
Comments by: Dr. Sheetal Singh, Senior Health Physicist, California Department of Public Health, Environmental Management Branch, comments dated May 15, 2018; comments received May 16, 2018	
13. Section 5.5 ("Survey Instrumentation"), Page 5-4. Paragraph 1, Sentence 2: Instrumentation listed in Table 4 for Alpha/Beta surveys is a Ludlum Model 43-37 attached to a Ludlum Model 2221. Since this instrument cannot differentiate between alpha and beta in the field please explain how the instrument will be utilized.	Table 4 and the Work Plan text were revised throughout to state alpha and beta radiation will be measured using scans and static measurements using a Ludlum Model 43-37 connected a Ludlum Model 2360 (or equivalent).
14. Section 5.5.1 ("Instrument Setup and Quality Control"), Page 5-5. last sentence: "A Chi-square test will also be performed according to procedure to maintain QC compliance for Ludlum Model 2929/3030 (smear counter) and Ludlum Model 2360 ratemeter/scaler (direct measurement)." In Table 4 of this work plan there is no mention of a 2360 utilized for alpha/beta scans or statics, instead only Ludlum Model 2221 is listed. Please correct as needed.	Table 4 was revised to include the Ludlum Model 2360 for alpha/beta scan and static measurements.
15. Section 5.5.3 ("Gamma Surface Scan Minimum Detectable Concentration"), Page 5-7. First full paragraph on page, Last Sentence: The word "foil" is used instead of "soil". Please change to "soil".	The text was revised as requested.
16. Section 5.5.4 ("Alpha and Beta Instrumentation"), Page 5-7. Sentence 2: "Total alpha and beta radiation will be measured using scans and static measurements using a Ludlum 43-37 gas proportional detector connected to a Ludlum Model 2221 ratemeter/scaler, or equivalent." A Ludlum Model 2221 is a single channel analyzer incapable of distinguishing between both alpha and beta radiation in one static or scan and must be specifically calibrated for either alpha or beta radiation. How will the Ludlum 2221 or equivalent be utilized on-site to collect both alpha and beta results?	The text was revised as follows: "Total alpha and beta radiation will be measured using scans and static measurements using a Ludlum 43-37 gas proportional detector connected to a Ludlum Model <u>2360</u> ratemeter/scaler, or equivalent."
17. Section 5.6 ("Gamma Count Rate Surveys :), Page 5-9. Paragraph 2. Sentence 2: "Systematic gamma static measurements will be collected as part of the second stage of the survey." Please clarify whether biased statics measurements based on elevated location identification will be collected along with systematic gamma static measurements.	The text was revised to state: "<u>Biased</u> gamma static measurements will be collected as part of the second stage of the survey."
18. Section 5.6 ("Gamma Count Rate Surveys"), Page 5-9. Paragraph 2. Sentence 1: Please specify whether that reacquisition of elevated gamma scan locations will be performed using the same GPS unit or equivalent that originally captured the data.	The text was revised as follows: "Static measurements will consist of reacquiring the location of the elevated gamma count rate and conducting a 1-minute gamma static count using a Ludlum Model 44-20 3-inch by 3-inch NaI gamma scintillation detector coupled with a Ludlum Model 2221 ratemeter/scaler, or equivalent, handheld instrument. <u>A high resolution GPS receiver will record all gamma scan, static, and biased</u>

	locations. The RS-700 has an internal GPS system, which displays real time data collection. An additional GPS receiver will be used to verify locations of interest using handheld meter Model 2221 coupled with Model 44-20 NaI detector for the static and biased locations. The nearby area will be resurveyed to assess if the elevated gamma scan reading is due to a point source or distributed radioactive material. If the gamma static (1 minute) count is less than the instrument specific static IL and there is no evidence of a point source, further survey investigation is not required.”
19. Section 5.7.2 ("Systematic Alpha and Beta Static Measurements"), Page 5-10: Please explain why this section discusses random measurement locations and not systematic static measurements as stated in the section title.	The text was revised to remove the word “Systematic” from the section heading.
20. Section 5.8 ("Remediation Approach and Radiological object Management"), Page 5-12. Paragraph 1. Sentence 2: **a.** “If the material is soil..." Please see comment# 7 **b.** Sentence 4: Remove the word "by" to make sentence read, "Under RCT oversight, the location with an elevated radiation level will be removed using whatever means necessary." **c.** The term "removed" is used instead of "remediated" please explain the choice of terminology.	a. Please see the response to CDPH Comment Number 7. b. The text was revised as requested. c. The text was revised to state “remediated” instead of “removed.”
21. Section 6.5 ("Mobilization"), Paragraph 1. Sentence 3: "... will be notified regarding the planned schedule for mobilization and site remediation activities." Why are the activities referred to as remediation activities in this characterization work plan?	The text was revised to state “characterization” instead of “remediation.”
22. Section 6.5 ("Mobilization"), Page 6-2. Paragraph 2. Sentence 2: Please specify whether the short and long-term storage of materials will solely be for non-radiological materials.	Short and long-term storage of materials will include non-radiological and radiological materials. Site activities will consist of radiological surveys and will require sources of radioactivity to calibrate and monitor the performance of radiation detection instrumentation. Radiological materials will be stored in posted, controlled, secured areas.
23. Section 6.6.1 ("Temporary Construction Facilities"), Page 6-2, Paragraph 1. Sentence 2: Same request as comment #22.	Please see the response to CDPH Comment Number 22.
24. Section 6.6.2 ("Field Observations and Photographic Documentation"). Page 6-3. Paragraph 1, Sentence 2: Please specify whether expected	The text was revised as follows:

weight loads include the vehicle (ATV or otherwise) that will be towing the RS-700.	"The expected loads include personnel and radiological equipment, including the RS-700 <u>system attached to an all-terrain vehicle for the drive over gamma scanning</u>."
25. **Sections 7.1.1 ("Gamma Scan Surveys") and 7.1.2 ("Alpha and Beta Surveys"):** Please provide explanation as to why manholes, grates, and components of the suction and discharge system are not to be surveyed for radiological contamination.	The first sentence of the second paragraph in Work Plan Section 7.1.2 states: "Manholes, grates, and components of the suction and discharge system will be investigated during the characterization survey of Drydocks 5, 6, and 7." No changes were made to the text.
26. **Section 7.1.2 ("Alpha and Beta Surveys"), Page 7-3:** Is the Navy planning to clean surfaces of debris as it may interfere with surveys?	Surface scans of MARSSIM Class 3 survey units are selected on a judgmental basis. Thus, it is not necessary to clear all the surface area of debris. If the location selected for scanning is covered by debris, it will be relocated as necessary to achieve a suitable surface scan. Work Plan Section 7.1.2, Alpha and Beta Surveys, was revised to state the following: "<u>Debris will be relocated as necessary to complete these scans</u>."
27. **Section 7.1.2 ("Alpha and Beta Surveys"), Page 7-3, Paragraph 1. Sentence 1:** This sentence implies that 25% of the accessible surfaces will be covered by a combination of alpha/beta scans, statics, and smears. This is in contradiction to a previous statement on page 5-10, first full paragraph, sentence 1, which states, "Alpha and beta static scans will be performed over 25 percent of the area of each SU." Please explain the change in area coverage methods.	The text was revised as follows for consistency: "Alpha and beta surveys will include scans, static measurements, and smear measurements for Class 3 areas consistent with MARSSIM guidance (NRC, et.al, 2000) for Class 3 surveys. <u>Alpha and beta static scans will be performed over 25 percent of the area of each SU</u>."
28. **Section 7.1.2 ("Alpha and Beta Surveys"), Page 7-3. Paragraph 2. Sentence 6:** The only Alpha/Beta scanning instrument mentioned in table 1 of the work plan is a Ludlum Model 43-37, please specify how the radiological control technician (RCT) performing the survey plans to access manholes, grates, and components of the suction and discharge system and maintain the same scanning procedure mentioned in Section 5.7.1.	Surfaces inaccessible with the Ludlum Model 43-37 (e.g., smaller than the detector, access smaller than the detector) or incompatible with the Ludlum Model 43-37 (e.g., curved surface) will not be included as part of the 25% of surfaces covered by alpha/beta static scan measurements.
29. **Section 7.1.2 ("Alpha and Beta Surveys"), Page 7-4, First Full Paragraph, Sentence 1 and 2:** These sentences imply that alpha/beta static surveys will consist of 6 second count times, while the following paragraph states that two minute count times will be collected; please explain	The text was revised as follows to clarify count times for alpha/beta static scans (i.e., "stamping") at 6-seconds each and alpha/beta static measurements at 2-minutes each: "The alpha/beta static measurements will be performed using portable contamination survey instruments specifically, the Ludlum Model 43-37 gas flow proportional "floor monitor" detector (or equivalent) coupled with a Ludlum Model <u>2360</u> scaler/ratemeter (or equivalent) (Table 4). The scaler/ratemeter will be set to a <u>2</u>-minute

	count time. At the start of each measurement, the RCT will position the detector, and begin the 2-minute count. At the completion of each 2-minute count, the alpha and beta result will be recorded. The IL for the alpha and beta static measurements will be developed and used as described in the decision rules in Section 5.4 of this Work Plan. The release criteria were established from the AM (Navy, 2006) and are presented in Table 1.”
30. Appendix A Sampling and Analysis Plan. ("SAP worksheet #17: Sampling Design and Rationale"), Page 45. Paragraph 2. Sentence 1: "A scoping survey that is also consistent with MARSSIM guidance (NRC et al., 2000) for Class 3 final status survey will be performed." Why is this survey referred to as a scoping survey in this section?	The text was revised to remove reference to “scoping surveys.” The text was revised as follows: “Surveys consistent with MARSSIM guidance (NRC et al., 2000) for a Class 3 final status survey will be performed.”
31. Appendix A Sampling and Analysis Plan. Section 17.1 ("Biased Radiological Characterization Sampling"), Page 45. Paragraph 2. Sentence 4: "If the results following the full ingrowth are consistent with background and gamma count rate scanning and static measurements are below instrument specific lLs, the radiological survey will be considered complete." Why are the alpha and beta results not considered?	This sentence refers to the review of laboratory gamma spectroscopy analysis and field data; it is not related to alpha and beta data collection or evaluation.
32. Appendix A Sampling and Analysis Plan. Worksheet #22 (" Field Equipment Calibration. Maintenance. Testing, and Inspection Table"), Page 50: Please furnish a copy of standard operating procedure (SOP) referenced under heading "SOP Reference", "Operation and use of portable instruments at HPNS (RPP[APTIM,2017a])").	The APTIM Radiation Detection Instrumentation Work Instruction (AMS-710-07-WI-04014) was added to Attachment 2.
33. Appendix A Sampling and Analysis Plan. Worksheet #34-36 ("Data Verification and validation (Steps I and lla/llb) Process Table"), Page 74: Please clarify verbiage. Illustrate that prior to sample shipment to off-site laboratory, sample release survey has been reviewed, accepted, and attached to the cooler by appropriate staff.	Text describing the sample release survey data documentation and review was added to WS#34-36.
34. Appendix B Contractor Quality Control Plan. Section 8.1 ("Definable Feature of Work 1: Radiological Surveys of Parcel F Structures"), Page 8-1: Change references from "Cabrera Large Area Scanning System" to RS-700 To remain consistent with the rest of the document.	Contractor Quality Control Plan, Section 8.1 was revised as requested.
35. Appendix C Waste Management Plan. Section 3.1 ("Waste Classification"), Page 2, Paragraph 1: Table 2 discusses methods of waste	Table 2 was revised to include analytical methods for total strontium/strontium-90 and plutonium-239.

characterization by gamma spectroscopy for identification of Ra-226 and Cs-137. Please explain why Pu-239 was excluded from the waste characterization process.	

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Comments by: Environmental Protection Agency, comments dated May 22, 2018; comments received May 22, 2018	
General Comments	**Response**
1. Section 2.3 (Nature and Extent) of the Draft Radiological Characterization Surveys Work Plan, Parcel F Structures, Hunters Point Naval Shipyard, San Francisco, California (Work Plan) states that surveys of the drydocks following decontamination operations did not identify areas of elevated radioactivity, indicating a low probability of finding residual radioactivity from contaminated ships. The text does not explain, however, what types of surveys were performed (gamma and/or alpha/beta) or what percentage of the drydocks were actually scanned. In order to demonstrate that the *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* classification of these Ship Berth areas is appropriate and to support the sufficiency of the proposed characterization plan, the Work Plan should include this information. For example, Section 5.1 (Classification and Survey Units) states that the Parcel F structures were classified as Class 3 areas. MARSSIM guidance states that Class 3 areas are impacted areas that are not expected to contain any residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the Derived Concentration Guideline Level for the wide area ($DCGL_W$), based on site operating history and previous radiation surveys. Historical information is especially important for the alpha/beta emitting radionuclides of concern (ROCs), Plutonium-239 (Pu-239), which is an alpha emitter, and Strontium-90 (Sr-90), which is a beta emitter, because the current Work Plan proposes to only survey 25% of the Parcel F structures for gross alpha/beta and includes survey units for the finger piers that are very large, around 7,000 – 8,000 square meters (m^2). Please revise the Work Plan to include information about the types and locations of previous radiological surveys of the Parcel F structures.	Previous radiological surveys in Parcel F are discussed in the *Final Historical Radiological Assessment Volume II, History of the Use of General Radioactive Materials, 1939–2003, Hunters Point Shipyard, San Francisco, California* (HRA; Naval Sea Systems Command, 2004). While the historical survey information is not sufficient to support a decision to release these areas from radiological controls, all historical survey data support a conclusion there is little or no residual radioactivity associated with these areas and they are consistent with classification as *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) Class 3 areas. There is no historical information indicating levels of residual radioactivity exceeding the current remediation goals. Activities historically performed in Parcel F involved radioactive materials; therefore, these areas are considered radiologically impacted. However, radiological activities were primarily completed approximately 60 years ago. Time and weathering of surfaces would be expected to reduce levels of potential surface residual radioactivity over this time. Starting with a low potential for residual radioactivity that has been reduced over time also supports classification as MARSSIM Class 3 areas. There is no historical information indicating plutonium-239 (^{239}Pu) was used for any purposes in Parcel F. Instead, ^{239}Pu was one of multiple radionuclides associated with nuclear weapons tests and fallout that could still be present at HPNS. This survey is designed to look for a mix of radionuclides emitting alpha, beta, and gamma radiation that could indicate residual radioactivity associated with nuclear weapons testing and fallout. Radium-226 (^{226}Ra) and strontium-90 (^{90}Sr) were used in radioluminescent devices. Residual radioactivity from these sources would result in photons being released (gamma and x-rays from ^{226}Ra decay, and bremsstrahlung from ^{90}Sr decay) that will be detected by the gamma scanning surveys. The gamma scanning survey is designed to identify discrete sources of photon emissions (^{226}Ra and ^{90}Sr radioluminescent devices) as well as delineate areas with elevated gamma radiation relative to surrounding areas (cesium-137 and fallout radiation). Alpha/beta scans are performed over 25 percent of surfaces to identify areas of elevated activity potentially

Response to Comments on the *Draft Radiological Characterization Surveys Work Plan, Parcel F Structures, Hunters Point Naval Shipyard, San Francisco, California,* February 2018, DCN: APTM-0006-4550-0014	
Comments by: Environmental Protection Agency, comments dated May 22, 2018; comments received May 22, 2018	
	associated with nuclear weapons testing or fallout, or traces of damaged radioluminescent devices. The 25 percent coverage is consistent with MARSSIM guidance for Class 3 final status surveys and should be adequate to characterize these areas in Parcel F. The alpha/beta random static measurements provide an estimate of the average levels of residual surface radioactivity for comparison with remediation goals to support decisions on releasing these areas in Parcel F from radiological controls.
1. Section 1.0 (Introduction) states that the Table 1 release limits/cleanup goals for localized radioactive contamination are based on the U.S. Nuclear Regulatory Commission (NRC) dose limit of 25 millirems per year. However, in order to demonstrate compliance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Contingency Plan (NCP), a risk assessment will need to be completed to demonstrate that future potential receptors will not be exposed to residual contamination that results in an Excess Lifetime Cancer Risk of greater than 10E-04 to 10E-06. U.S. EPA's "Radiation Risk Assessment at CERCLA Sites: Q & A" states "The PRG calculators (U.S. EPA 2002a, 2007, 2009a), which are used to develop risk-based PRGs for radionuclides, are recommended by EPA for Superfund remedial radiation risk assessments." (Source: https://epa-prgs.ornl.gov/radionuclides/RadRiskQAwithtransmitmemo_June_13_2014.pdf) As one of multiple lines of evidence, please revise the Work Plan include showing results from the EPA PRG Calculators for Parcel F. This addition would help demonstrate consistency with U.S. EPA's CERCLA approaches. The software is public and free. The human health PRG calculator is at https://epa-prgs.ornl.gov/radionuclides/ and the ecological risk version is at https://epa-eco.ornl.gov/radionuclides/. Please revise the Work Plan to discuss how it will be ensured that the final actions/end state of Parcel F structures will be evaluated to ensure risk to any potential receptor falls within the CERCLA acceptable risk range of 10E-06 to 10E-04.	The Table 1 release limits and remediation goals were established in the *Final Basewide Radiological Removal Action, Action Memorandum - Revision 2006, Hunters Point Shipyard, San Francisco, California* (Department of the Navy, 2006). The reference to the U.S. Nuclear Regulatory Commission dose limit of 25 millirems per year was removed.
2. It is unclear if the instrument efficiencies used to calculate the gamma spectrometry and alpha/beta survey surveys and static measurements Minimum Detectable Concentrations (MDCs) referenced in Section 5.5 (Survey Instrumentation), Table 5 of the Work Plan, and Worksheet #15 of the Appendix B Sampling and Analysis Plan, were adjusted to account for the various materials that will be surveyed, such as metal, wood, concrete, or	Instrument efficiencies, as defined in ISO-7503, are specific to an instrument and are independent of the source of radiation. Surface efficiencies may be developed for specific materials, but since the process requires a significant effort in terms of time and materials and adequate material-specific calibration sources are difficult or impossible to obtain, default values generally applicable to most situations were developed and

others. The instrument and matrix efficiencies have a significant impact on the achievable MDCs, therefore this information is critical for determining if the calculated MDCs can be met during the actual surveys. Please revise the Work Plan to discuss whether instrument efficiencies were adjusted for different materials (e.g., wood, metal, concrete, etc.) that will be surveyed at the ship berths areas.	included in ISO-7503. For this project, the default values from ISO-7503 will be used in place of developing material-specific surface efficiencies.
3. Table 3 lists the environmental background measurements collected from soil samples at the Hunter's Point Naval Shipyard; however, background measurements for other materials that will be surveyed for Parcel F structures are not included. Please ensure background measurements are collected from representative materials in order to support the MDCs, scan speeds, and static measurement times listed in the Work Plan.	Work Plan Section 5.3.2 states "Alpha/beta material-specific backgrounds will be established for each instrument based on measurements performed in the reference area."
Specific Comments	**Response**
1. Section 5.4.4, Step Four – Define the Study Boundaries, Page 5-3 and Appendix A, Sampling and Analysis Plan (SAP) Worksheet #11, Project Quality Objectives/Systematic Planning Process Statements, Page 30: The spatial boundaries are provided in the Step 4 discussion. Please also provide the temporal boundaries for this study.	There are no temporal boundaries associated with this project.
2. Section 7.1.2, Alpha and Beta Surveys, Page 7-4 and Section 7.3, Site Restoration, Page 7-5: The text in Section 7.1.2 states that cutting or sawing may be required to access manhole covers that are locked or welded in place or other plates or covers that limit access, but it is unclear how these areas will be secured to limit access after the surveys are completed. Section 7.3 states, Restoration of Parcel F structures is not expected or required," but subsurface structures should be left in an inaccessible condition. Please revise the Work Plan to discuss how areas where cutting or sawing is required to access manholes and other covered areas will be secured when the surveys are completed.	Prior to mobilization there is limited information available on what areas require access and what will be required to provide the required access. Similarly, there is limited information available on what will be required to limit access to these areas after the surveys are complete. Details on how access to areas was limited after completing the survey will be included in the final report.
3. Appendix A, SAP Worksheet #28.3, Laboratory Quality Control Samples -Alpha Spectroscopy, Pages 67 and 68: This worksheet does not include sample tracers as one of the quality control checks. Please revise the SAP to include the recovery of tracers to be included in this worksheet.	Tracer recovery was added to Worksheet #28.3.
4. Appendix A, SAP Worksheets #34-36, Data Verification and Validation (Steps I and IIa/IIb) Process Table, Page 76: The text states that validation (i.e., Stage 3) will be performed on 10 percent (%) of the samples, and 90 % will receive Stage 2 verification. It is requested that in addition to	As stated in Sampling and Analysis Plan Worksheets #34-#36, Page 79, Validation of Laboratory Data, a third-party data validation company will validate definitive-level project laboratory data for radiological confirmation samples, if collected, at 90 percent Stage 2B and 10 percent

	these requirements, data validation be performed on one or more of the initial data packages from the laboratory at the beginning of the project to ensure the quality of the data is sufficient and is meeting the data quality objectives (DQOs) for the project. Please revise Worksheets #34-36 to require data validation of at least one of the initial data packages from the laboratory to ensure the DQOs are being met.	Stage 3. If samples are collected and sent to the off-site laboratory for analysis, the data will be validated. All data packages will be validated.
4.	**Appendix A, SAP Worksheet #37, Usability Assessment, Pages 78-81:** This worksheet describes the process that will be followed to perform a data usability assessment but does not specify the frequency of such reviews. Additionally, neither SAP Worksheets #34-36: Data Verification and Validation (Steps I and IIa/IIb) Process, nor Worksheet #37 states how the results of such an assessment will be documented and reviewed or what process will be followed if the data usability assessment (DQA) indicates the data are not usable. Please revise Worksheet #37 to include the percentage/frequency of data packages that will be subject to a data usability assessment, how these reviews will be documented and reviewed, and what process will be followed if anomalies are noted in the DQA and/or data are deemed not usable for decision making.	The following sentence was added to Section 37.1, Data Quality Assessment Report, second paragraph: "A data usability assessment based on data quality indicators will be performed for every data set subjected to Class 3 validation (SAP Worksheet #34-36)." Data usability for project decisions is continually assessed throughout the project with the Project Radiological Safety Officer and the Navy, including the Radiological Affairs Support Office. If data are determined unusable for project decisions, re-sampling is conducted.

Response to Comments on the *Final Radiological Characterization Surveys Work Plan, Parcel F Structures, Hunters Point Naval Shipyard, San Francisco, California,* July 2018, DCN: APTM-0006-4550-0025

Comments by: Sheetal Singh, Senior Health Physicist, CDPH, comments dated August 15, 2018

Specific Comment	Response
1. CDPH-EMB's Specific Comment 8(a) addresses concern with classification of Parcel F structures as MARSSIM Class 3 survey units (SUs). Historically the Navy has classified these structures as MARSSIM Class 1 SUs. This classification of MARSSIM Class 1 SUs is justified by the fact that radiological activities listed below have taken place on the Parcel F structures: a) Berthing and decontamination of Operation Crossroads vessels, b) Naval Nuclear Propulsion Program Operations, c) Berthing of YGN-73 radioactive waste disposal barge, d) Berthing of Naval Radiological Defense Laboratory (NRDL) experimental barges and YAG-39 and YAG-40, e) And radioactive waste staging on the piers prior to loading onto YGN-73. Due to various radiological activities listed above and the historical classification of similar structures, the response provided is inadequate to justify down-classification of these structures to MARSSIM Class 3 SUs.	The impacted categorization of the Parcel F structures is consistent with the list of Navy activities provided in the California Department of Public Health's (CDPH's) comment, and the discussions provided in the *Final Historical Radiological Assessment Volume II, History of the Use of General Radioactive Materials, 1939–2003, Hunters Point Shipyard, San Francisco, California* (HRA; Naval Sea Systems Command, 2004). The classification of the submarine pens and piers at Hunters Point Naval Shipyard (HPNS) as Class 3 areas is consistent with the historical use of these areas and what is known about these sites. The HRA (Naval Sea Systems Command, 2004) describes the potential for contamination of Parcel F ships' berths as likely, meaning the sites were impacted by past historical radiological activities performed by the Navy (i.e. items a-e listed in CDPH's comment 1). Further the HRA states the Navy's recommended actions include Scoping Surveys be completed for the ship berths. Although the potential for contamination is conservatively classified as "likely" (due to historical activities), HRA Section 8.3.7.2 states the current potential for contaminated media including soil, groundwater, structures, drainage systems and surrounding air as low or none. As defined in the HRA, a low potential categorization for media contamination indicates that the contamination potential is remote. While it was possible for submarine pens and piers to have come into contact with radioactive material in the past, the potential for any residual radioactivity to be present today is little to none. This is consistent with a *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) classification for Class 3 areas where there is little to no potential for a dose above the release criterion, or in this case, little to no potential for radionuclide concentrations exceeding the release criteria listed in Table 1 of the Work Plan. While classification of structures or areas with similar historical use of radioactive materials may be considered, the historical use of radioactive materials at each site should be the primary consideration when assigning survey class classifications. In this case, there are no other submarine pens and piers at Hunters Point Naval Shipyard (HPNS) with similar history for

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	use of radioactive materials. Other areas at HPNS, such as the Gun Mole Pier, have a significantly different historical use and should not be compared directly with other sites and areas at HPNS. If radiological contamination is discovered during the survey, the Parcel F submarine pens and/or finger piers exceeding the release criteria listed in Table 1 of the Work Plan, will be re-surveyed as Class 1 areas. If no radiological contamination is discovered, the Parcel F structures will be recommended for unrestricted radiological release. Work Plan Section 5.1, Classification and Survey Units, was revised to include this text.
2. CDPH-EMB's Specific Comment 28 addresses its concerns pertaining to large area detector access to smaller components and entryways (i.e. manholes, grates, and associated structure components) while maintaining proper scanning procedures. Components and entryways maintain the same potential for radiological contamination as the rest of the structure. Therefore, the response that these components and entryways "will not be included as part of the 25% of surfaces covered by alpha/beta static scan measurements" is unacceptable. Disqualifying scan surfaces simply based on accessibility of large area detectors is unacceptable. Smaller area detectors should be utilized to scan areas inaccessible to large area detectors.	Small area detectors do not meet the survey data objectives for scanning because the scan detection limits for the small area detectors are higher than allowed. Detectors that meet the survey data objectives do not fit inside small penetrations inside the submarine pens. The potential for residual radioactivity at smaller components and entryways is considered low. These components would have been impacted by the flow of contaminated water through the system and not by direct contact of contaminated items. Ships were at sea for days or weeks prior to entering the submarine pens, so readily removable contamination would have been removed prior to entering the submarine pen. The time to secure and drain the submarine pen was several hours, so the potential for transferring additional contamination to the water following several days in the water is extremely small. The potential for contamination in the water being pumped out of the submarine pens is also small. The potential for contamination is higher on the walls of the submarine pens; therefore, the walls of the submarine pens will be surveyed preferentially. To ensure no areas are disqualified from the survey due to accessibility or large area detectors, static measurements with smaller detectors will be performed in selected locations. The Work Plan Sections 5.5.6, 7.1.2, and Tables 4 and 5 were revised to include small area detectors for collection of alpha/beta static measurements. Work Plan Section 5.5.6, Alpha Beta Static Minimum Detectable Concentration, was revised as follows: "Integrated static alpha and beta activity measurements will be performed using a Ludlum Model 43 37 gas proportional detector

	during scans. A Ludlum Model 43-68 gas proportional detector may be used in areas inaccessible to the large area detector." "Two-minute static measurements will be performed when using the Ludlum Model 43-37. Based on the backgrounds and efficiencies experienced using the Ludlum Model 43 37, the *a priori* MDC for alpha is 21.5 dpm/100cm^2 and for beta is 184 dpm/100cm^2. Five-minute static measurements will be performed when using the Ludlum Model 43-68. Based on the backgrounds and efficiencies experienced using the Ludlum Model 43-68, the *a priori* MDC for alpha is 32 dpm/100cm^2 and for beta is 202 dpm/100cm^2." Work Plan Section 7.1.2, Alpha and Beta Surveys, was revised as follows: "The alpha/beta static measurements will be performed using portable contamination survey instruments specifically, the Ludlum Model 43 37 gas flow proportional "floor monitor" detector (or equivalent) coupled with a Ludlum Model 2360 scaler/ratemeter (or equivalent) (Table 4). If required, a Ludlum Model 43-68 gas flow proportional detector (or equivalent) small area detector may be used to perform static measurements in areas not accessible to the Ludlum Model 43-37 large area detector (Table 4)." Tables 4 and 5 were revised to include the Ludlum Model 43-68 detector for alpha/beta static measurements.

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Comments by: Lily Lee, Cleanup Project Manager, EPA, comments dated August 23, 2018	
Specific Comment	**Response**
1. Evaluation of the Response to General Comment 1: Currently, the Work Plan classifies Parcel F structures as Class 3 survey units and has proposed conducting radiological surveys of 25 percent (%) of these structures. The RTCs have not sufficiently justified a Class 3 designation. EPA agrees with the California Department of Public Health Specific Comment #1 on the RTCs, which lists relevant historical radiological activities and which recommends a Class 1 designation. Also, no records have established where ships from Operation Crossroads were berthed. Dry Docks 2-7 and the Gun Mole Pier are all considered radiological impacted. When the Navy surveyed onshore drydock areas adjacent to the piers and sub pens, radiological devices were found. The piers removed from Parcel B were removed as potentially radiologically impacted. In addition, the response is incomplete because it does not address the potential for the presence of elevated alpha activity on outdoor metal surfaces in Parcel F due to the sequestering of Polonium 210 (Po-210) from the decay of Radium-226 (Ra-226), which has been identified on metal structures at other areas of the Hunter's Point Naval Shipyard. The response states that the time and weathering of surfaces on Parcel F would be expected to reduce levels of potential surface residual radioactivity over time; however, Po-210 may increase the alpha radioactivity on surfaces over time. However, given the identification of elevated alpha activity above the release criteria on other surfaces throughout the Hunter's Point site due to the concentration of Po-210 from the presence of Ra-226, metal structures in Parcel F should be considered potentially impacted above the remedial goal (RG) and therefore should be classified as Class 1 survey units and receive more thorough evaluation to determine if the release criteria for these surfaces has been met. Please revise the Work Plan to reclassify these survey units to Class 1 and specify that 100% gross alpha/beta surveys and smear sampling for gross alpha of metal surfaces of structures located in areas of Parcel F that may be released for public access will be conducted to ensure the RGs have been met and to identify whether any of those surfaces have elevated levels of Po-210 that may pose a safety risk to potential future receptors.	The Work Plan classifies the Parcel F submarine pens and piers as Class 3 areas based on the historical use and what is known about these sites. Please refer to California Department of Public Health (CDPH) Comment 1, dated August 15, 2018, CDPH Comment 8a, dated May 15, 2018, and *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) guidance for additional discussions concerning classification of these areas. As stated in the response to CDPH's Comment 1, dated August 15, 2008, if radiological contamination is discovered above the release criteria (listed in Table 1 of the Work Plan) during the survey, then said Parcel F submarine pens and/or finger piers will be re-surveyed as Class 1 areas. If no radiological contamination is discovered, the Parcel F structures will be recommended for unrestricted radiological release. The Work Plan proposes 100 percent (%) survey for photons and 25% surveys for alpha and beta surface activity, which is consistent with MARSSIM guidance for Class 3 final status surveys. Work Plan Section 7.1.2, Alpha and Beta Surveys, states a minimum of one alpha/beta static measurement and one smear measurement will be collected from each accessible manhole and outlet impeller (or similar equipment) if safely accessible. Other components of the discharge system (i.e., metal plates and piping) will be visually inspected in the field and surveyed as practicable; scan, static measurements, and smear measurements will be collected from accessible surfaces as practicable. The samples may be biased to visible staining based on the direction and professional judgement of the Project Radiological Safety Officer. As determined in the *Final Historical Radiological Assessment Volume II, History of the Use of General Radioactive Materials, 1939–2003, Hunters Point Shipyard, San Francisco, California* (HRA; Naval Sea Systems Command, 2004), the radionuclides of concern (ROCs) for the Parcel F structures are cesium-137, plutonium-239, radium-226, and strontium-90. Polonium 210 (Po-210) is not identified as a ROC in the HRA for the Parcel F submarine pens and piers. The Navy concurs that Po-210 has been detected on outdoor metal structures at other areas of HPNS. However, the Navy has determined that

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Comments by: Lily Lee, Cleanup Project Manager, EPA, comments dated August 23, 2018	
	sequestering of Po-210 on metal structures is attributable to naturally occurring plating of radon and not related to historical Navy activities.
2. Evaluation of the Response to General Comment 1, Section 1.0 (Introduction): The response does not address EPA's comment that as part of the fourth Five-Year Review occurring in parallel this year, the Navy should perform updated risk evaluations of existing RGs using the current versions of the EPA's radiological risk models. These include the Preliminary Remediation Goals (PRG) Calculator for soil, the Building PRG Calculator for buildings and the Surface PRG Calculator for surfaces. The new work performed under this Work Plan should use cleanup criteria that reflect findings of the updated risk evaluations to ensure the protectiveness of the cleanup. Please revise the Work Plan include the results of the risk evaluation of current RGs and to include risk analysis (or refer to such analysis in the Five Year Review or other document) using the current version of the relevant PRG Calculator(s) for the structures to demonstrate that planned cleanup will protect any potential receptor to the CERCLA acceptable Excess Lifetime Cancer risk range of 10E-06 to 10E-04 using exposure pathways and scenarios specific to each structure.	The Parcel F Work Plan uses the current remedial goals (RGs) as established in the *Final Basewide Radiological Removal Action, Action Memorandum - Revision 2006, Hunters Point Shipyard, San Francisco, California* (Department of the Navy, 2006). The Navy conducted preliminary calculations of the risk using the U.S. Environmental Protection Agency's Preliminary Remediation Goal Calculator and found that the current RGs are within the risk management range of 10^{-4} to 10^{-6}. RGs are not proposed to be changed as part of this work plan. Future protectiveness will be evaluated in the Five Year Review.

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Comments by: Lily Lee, Cleanup Project Manager, EPA, comments dated November 15, 2018	
Specific Comment	**Response**
1. Evaluation of the Response to Specific Comment 1: The response states that if radiological contamination is discovered above the release criteria (listed in Table 1 of the Final Radiological Characterization Surveys Work Plan, Parcel F Structures [Work Plan]) during the survey, then the survey unit (e.g., Parcel F submarine pens and/or finger piers) will be re-surveyed as Class 1 areas; however, this commitment is not documented in the Final Radiological Characterization Surveys Work Plan, Parcel F Structures, Hunters Point Naval Shipyard, San Francisco, California, July 2018 (WP). Therefore, the decision rules, Sections 5.6 and 5.7 of the Work Plan, and Worksheets #11, 14, and 17 of the Appendix A Sampling and Analysis Plan and other sections as appropriate should be updated to require a Class 1 survey if radiological contamination is found. Please submit change pages that document the commitment to surveying all of the Parcel F structures as MARSSIM Class 1 survey units if contamination is identified during any of the characterization surveys.	Work Plan Section 5.4.2, Step Two-Identify the Decision, second bullet, and Sampling and Analysis (SAP) Worksheet (WS) #11, Step 2, second bullet were revised as follows: • "If residual radioactivity is found during the radiological surveys at levels that would prevent unrestricted release of the site, then the Navy will be notified of the presence of residual radioactivity to determine the appropriate next steps for further investigation <u>and the areas will be re-surveyed as Class 1 areas."</u> SAP WS#14 summarizes the project tasks for the current work and WS#17 describes the sampling design and rationale. These worksheets are based on performing a Class 3 survey. If contamination is found, the areas will be re-surveyed as Class 1 areas. The Work Plan and SAP will be revised if Class 1 surveys are required. Work Plan Sections 5.6 and 5.7 and SAP WSs #14 and ##17 are correct as written and no changes were made.